NS&T Program

National Status and Trends Program
for Marine Environmental Quality

FLORIDA PANHANDLE

Great egret (South Florida Water Management District)

National Oceanic and Atmospheric Administration
National Ocean Service
National Centers for Coastal Ocean Science
Center for Coastal Monitoring and Assessment

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Status and Trends of Contaminant Levels in Biota and Sediments of the FLORIDA PANHANDLE

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INTRODUCTION

As part of its continuing mission to bring important results into the public arena, the NOAA National Status and Trends (NS&T) Program has prepared this summary of its findings in four estuaries in the Florida Panhandle: Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays (Figure 1). Several recreation areas are located along this section of the Florida coast including the Gulf Islands National Seashore.

AREA DESCRIPTION

Three major rivers drain into Pensacola Bay: the Escambia, Blackwater and Yellow rivers. High concentrations of Hg have been found in the tissue of largemouth bass caught in these rivers. Urbanization around the city of Pensacola appears to be the principal source of contamination to Bay waters. The Pensacola Bay Naval Air Station, located in the area, has been in operation since World War I. Pensacola Bay is frequently used as a port by the US Navy and is the home port of the aircraft carrier LEXINGTON and the destroyer OWENS. In addition to the Navy, other military organizations active in the area include the Marine Corps, Air Force, Coast Guard and foreign military units (U.S. Air Force, 1999a).

There are three Mussel Watch Project sampling sites in Pensacola: Public Harbor (PBPH), Indian Bayou (PBIB), and Sabine Point (PBSP). The Sabine Point site is on the bridge that crosses to Santa Rosa Island, over the Intercoastal Waterway. The site at Indian Bayou is located on the west entrance of the Bayou. The site at Public Harbor is located on the Pensacola Fishing Pier on the Highway 89 bridge. There is one Benthic Surveillance Project site in Pensacola Bay (PENPB) located in Bayou Texzar on the north side of the Bay, west of Emanuel Point.

Choctawhatchee Bay is located east of Pensacola Bay. Its main source of fresh water is the Choctawhatchee River, the fourth largest river in terms of flow in the state with a drainage basin of over 10,400 sq km (4000 sq mi). The Bay is bordered by Choctawhatchee River and forest land on the east, northeast and by major developed urban areas on the west and northwest including Destin, Fort Walton Beach, Niceville-Valparaiso and Eglin Air Force Base (AFB). The primary source of saline water is through East Pass. A comprehensive description of the environmental status of Choctawhatchee Bay can be found in the Eglin AFB internet web site (U.S. Air Force, 1999b). Eglin AFB, established in 1935, is one of the largest Air Force bases in the world and one of the Department of Defense's major range and test facility bases, consisting of approximately

463,000 acres of land and 86,500 square miles of water. The core purpose of the Air Force Development Test Center based at Eglin is to provide a national capability for test and evaluation of defense weapon systems. Eglin AFB schedules and uses special-use airspace and military operations areas in northwest Florida, Alabama, and the Gulf of Mexico as far south as Key West. Eglin AFB supports approximately 50 associated units including U.S. Air Force, Army, Navy, and the Federal Bureau of Investigation (U.S. Air Force, 1999c).

There are five Mussel Watch sites in the Choctawhatchee Bay area: Ben's Lake (CBBL), Boggy Bayou (CBBB), Postil Point (CBPP), Joe's Bayou (CBJB), and Off Santa Rosa (CBSR). The five sites are encompassed by Eglin AFB. The site off Santa Rosa is an oyster reef near the Highway 331 bridge. The Joe's Bayou site is on the south shore of the Bay, at the mouth of the bayou. The site at Ben's Lake is located at the entrance to the Lake which is on the northern side of the Bay. The Postil Point site is located on the west bank at the entrance into Boggy Bayou which is located on the north side of Choctawhatchee Bay. Boggy Bayou oysters were collected on the concrete pilling on the bridge which crosses Tom's Bayou. The site at Joe's Bayou (CBJB) is located on the south shore of Choctawhatchee Bay, at the mouth of the Bayou. Joe's Bayou is primarily surrounded by private residences but with a sand and gravel business located near the site. There are two Benthic Surveillance sites in the Bay: Choctawhatchee Bay (COCCB) and Destin Harbor (COCDH). The Benthic Surveillance site at Destin Harbor is located at the eastern side, near the Choctawhatchee Bay entrance. Of the NS&T monitoring sites in the area, COCDH is the farthest from the main basin of Choctawhatchee Bay and may have contaminant influences that are not characteristic of Choctawhatchee Bay. The Choctawhatchee Bay site is located north of Grassy Cove, north of Horseshow Bayou and southeast of Big Hammock Point in the

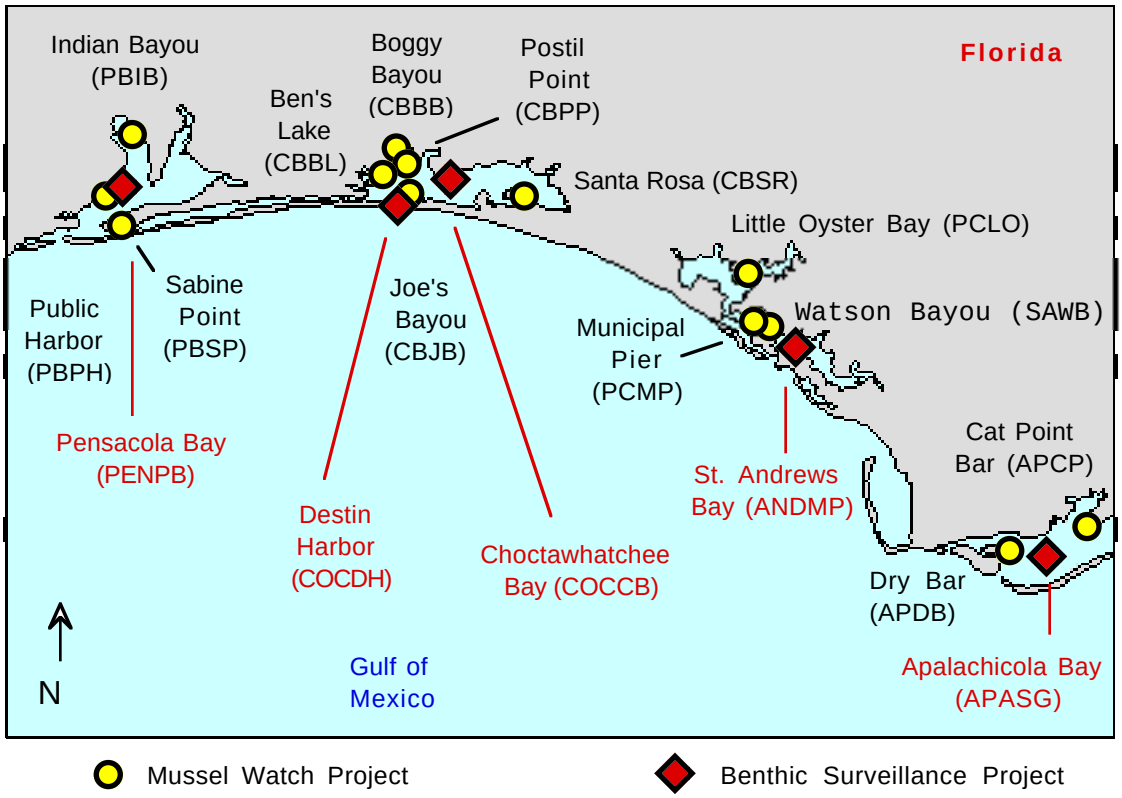


Figure 1. NS&T Mussel Watch and Benthic Surveillance sampling sites in the Florida Panhandle.

center of the Bay. The other site is located on the east end of Destin Harbor, near the Bay entrance.

The St. Andrew Bay system is one of the most diverse bays in North America, and has the largest expanse of seagrass beds in the Florida Panhandle (State of Florida, 1999a). The Bay has little fresh water input compared to other bay systems in the Panhandle. The major freshwater sources are spring-fed streams. This aquatic preserve contains a variety of habitats from the hard bottom areas of the jetties to extensive seagrass beds within the portion of the preserve located in the Bay.

The three Mussel Watch sites in the St. Andrews Bay-Panama City area are: Watson Bayou (SAWB), Municipal Pier (PCMP), and Little Oyster Bar (PCLO). The site at Little Oyster Bar is located on the edge of the US Air Force Petroleum Depot. The site at Municipal Pier is located at the Bay City Marina in Panama City. The site at Watson Bayou east of the Bay City Marine is in Panama City. There is one Benthic Surveillance Project site (ANDMP) in St. Andrews Bay located at Military Point.

The Apalachicola River Basin is part of the larger Apalachicola-Chattahoochee-Flint (ACF) River system (Apalachicola NERR, 1999). The ACF basin covers the north-central and southwestern part of Georgia, the southeastern part of Alabama, and the central part of the Florida Panhandle, draining an area of approximately 19,600 square miles. The Apalachicola River, the largest river in Florida, is formed by the confluence of the Chattahoochee and Flint rivers and drains a land area of approximately 2,400 square miles. The Apalachicola Bay Aquatic Preserve lies within the Apalachicola National Estuarine Research Reserve (State of Florida, 1999b).

There are two Mussel Watch sites in Apalachicola Bay: Cat Point Bar (APCP) and Dry Bar (APDB). The site at Cat Point Bar is located to the east of Cat Point, at an exposed oyster reef which is a major source of oysters for the Bay. The site at Dry Bar is located at St. Vincent Point on St. Vincent Island. There is one Benthic Surveillance site (APASG) at St. George Island.

NATIONAL STATUS AND TRENDS PROGRAM

Our Nation's estuaries and coastal waters receive chemical wastes from industrial, municipal, and agricultural sources. In recent decades, as industrialization has grown and diversified, complex mixtures of synthetic organic compounds, trace elements, and nutrients have been discharged into US coastal waters.

In addition to industrial sources, contaminants are released to the environment in the course of our daily lives. For generations, chemicals from such non-point sources as agricultural runoff, urban runoff and non-agricultural insect and plant control programs have added significantly to the total burden of coastal contaminants. Airborne transport is another significant source of contaminants to coastal ecosystems. In recent years, coastal contamination has become more of a concern as population growth in these areas has continued to increase steadily. In response, an evolving national effort is underway to determine the extent and impact of contaminants on coastal and estuarine areas and to develop management strategies.

The Center for Coastal Monitoring and Assessment (CCMA), in the National Centers for Coastal Ocean Science (NCCOS) of NOAA's National Ocean Service, conducts a variety of environmental monitoring and assessment studies that are pertinent to NOAA's Environmental Stewardship mission, as outlined in its Strategic Plan: "A Vision for 2005". These studies focus on three long-term goals:

- Assess the status and trends of environmental quality in relation to levels and effects of contaminants and other sources of environmental degradation in US marine, estuarine, and Great Lakes environments;
- Develop diagnostic and predictive capabilities to determine effects of contaminants and other sources of environmental degradation on coastal and marine resources and human uses of these resources;

- Develop and disseminate scientifically sound data, information, and services to support effective coastal management and decision making.

NOAA's NS&T Program, managed by CCMA, was initiated in 1984 to determine the status of, and to detect changes in, the environmental quality of the nation's coastal waters. This program monitors contaminant levels through the **Mussel Watch Project,** which determines concentrations of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCB) congeners, several pesticides, butyltins, and selected trace elements in sediment and mollusk samples from U.S. coastal waters (Table 1). Data are used to determine the extent and temporal trends of chemical contamination on a nationwide basis and to identify which coastal areas are at greater risk in terms of threats to environmental quality. The Mussel Watch network consists of more than 280 sites. The **Quality Assurance Project** is designed to document sampling protocols, analytical procedures, and laboratory performances of the Mussel Watch Project and is an integral part of the NS&T Program.

SURVEY METHODS

Mussel Watch Project sites are sampled at regular intervals (biennially in winter for mollusks, less frequently for sediments). The sites are designed to describe national and regional distributions of contamination. Mussel Watch sites are selected to represent large coastal areas and to avoid small-scale patches of contamination, or "hot spots." Sites selected for monitoring are generally 10 to 100 km apart. Where possible, sites were selected to coincide with historical monitoring sites such as the Environmental Protection Agency's Mussel Watch sites sampled during the 1970s, and to complement sites sampled through state programs such as the California Mussel Watch Program (Lauenstein, 1996).

Mollusks (mussels or oysters) and sediments are collected at each Mussel Watch Project site. Several species of mollusks are collected: blue mussels (Mytilus edulis) from the US North Atlantic; blue mussels (Mytilus species) and California mussels (M. californianus) from the Pacific coast; eastern oysters (Crassostrea virginica) from the South Atlantic and the Gulf of Mexico; smooth-edge jewelbox (Chama sinuosa) from the Florida Keys; Caribbean oyster (C. rhizophorae) from Puerto Rico; Hawaiian oysters (Ostrea sandvicensis) from Hawaii; and zebra mussels (Dreissena polymorpha and D. bugensis) from the Great Lakes. Coastal and estuarine mollusks are collected by hand or dredged from intertidal to shallow subtidal zones, brushed clean, packed in dry ice, and shipped to the analytical laboratory. Sediments are collected using a grab sampler and the top two centimeters are removed for analysis. The mollusk and sediment samples are usually shipped to the laboratory within a day of collection.

In the laboratory, molluscan samples are composited to include about 20 or 30 individuals for oysters and mussels, respectively. The molluscan composite samples and sediment samples are analyzed for organic and metal contaminants. The sampling and analytical protocols are described in detail in Lauenstein and Cantillo (1993, 1998). Data are also available from the NS&T **Benthic Surveillance Project** that analyzed contaminant levels and effects in sediment and fish from over 100 sites in 1984 through 1992. This Project's sediment data are combined with those of the Mussel Watch Project data in this report.

The NS&T Mussel Watch and Benthic Surveillance sites in the Florida Panhandle are shown in Figure 1. The site names, acronyms, latitudes and longitudes, years of data available and human populations within 20 km of the sites are listed in Table 2 and shown in Figure 2.

The average concentrations of major and trace elements and of categories of organic compounds in sediment are shown graphically in Appendix I. Appendix II provides graphical representations of trace element and organic concentrations in oysters through time at the sampling sites in the Florida Panhandle.

TABLE 1

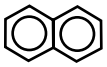
Organic contaminants and major and trace elements determined as part of the NS&T Program.

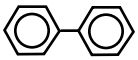
(Number below chemical structure is the Chemical Abstracts Service registry number.)

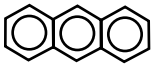
Polycyclic aromatic hydrocarbons

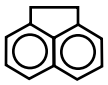
Low molecular weight PAHs
(2- and 3-ring structures)

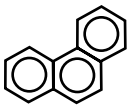
1-Methylnaphthalene
1-Methylphenanthrene
2-Methylnaphthalene
2,6-Dimethylnaphthalene
1,6,7-Trimethylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Biphenyl
Fluorene
Naphthalene
Phenanthrene


Naphthalene
91-20-3

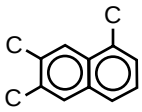

Biphenyl
92-52-4

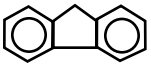

Anthracene
120-12-7

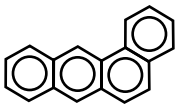

Acenaphthene
83-32-9

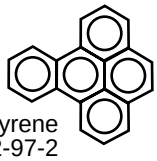

Phenanthrene
85-01-8

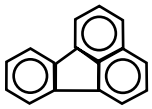

Acenaphthylene
208-96-8

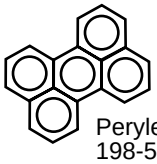

1,6,7-Trimethylnaphthalene
2245-38-7

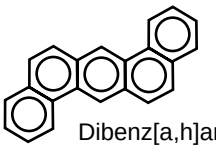

Fluorene
86-73-7

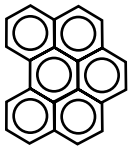

Benz[a]anthracene
56-55-3


Benzo[e]pyrene
192-97-2


Fluoranthene
206-44-0


Perylene
198-55-0


Dibenz[a,h]anthracene
53-70-3

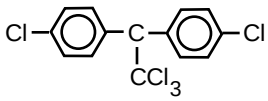

Benzo[ghi]perylene
191-24-2

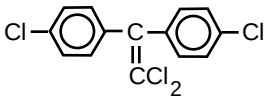
High molecular weight PAHs
(4-, 5-, and 6-rings)

Benz[a]anthracene
Benzo[a]pyrene
Benzo[b]fluoranthene
Benzo[e]pyrene
Benzo[ghi]perylene
Benzo[k]fluoranthene
Chrysene
Dibenz[a,h]anthracene
Fluoranthene
Indeno[1,2,3-cd]pyrene
Perylene
Pyrene

Chlorinated pesticides

2,4'-DDD
4,4'-DDD
2,4'-DDE
4,4'-DDE
2,4'-DDT
4,4'-DDT


4,4'-DDT
50-29-3


4,4'-DDE
72-55-9

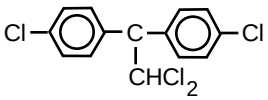
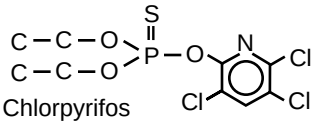

4,4'-DDD
72-54-8

TABLE 1 (cont.)

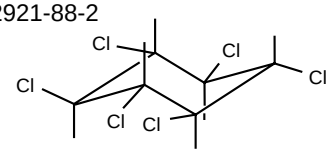
Organic contaminants, and major and trace elements determined as part of the NS&T Program.

(Number below chemical structure is the Chemical Abstracts Service registry number.)

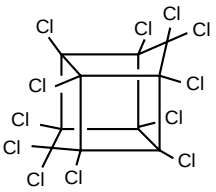
Aldrin
Chlorpyrifos
cis-Chlordane
Dieldrin
Endosulfan-II
delta-Hexachlorocyclohexane
gamma-Hexachlorocyclohexane
(Lindane)
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
alpha-Hexachlorocyclohexane
beta-Hexachlorocyclohexane
Mirex
cis-Nonachlor
trans-Nonachlor
Oxychlordane



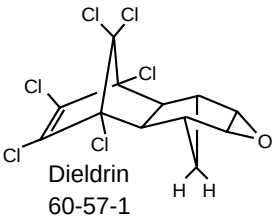
Chlorpyrifos
2921-88-2



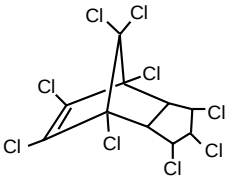
gamma-Hexachlorocyclohexane
58-89-9



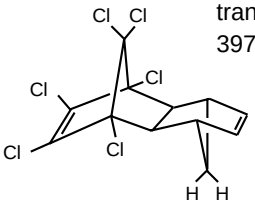
Mirex
2385-85-5



Dieldrin
60-57-1



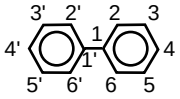
trans-Nonachlor
39765-80-5



Aldrin
309-00-2

Polychlorinated biphenyl congeners (IUPAC numbering system)

PCB 8, PCB 18, PCB 28, PCB 44, PCB 52, PCB 66, PCB 101, PCB 105, PCB 118, PCB 128, PCB 138, PCB 153, PCB 170, PCB 180, PCB 187, PCB 195, PCB 206, PCB 209

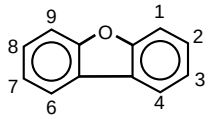


PCB parent structure

Planar PCBs (PCB 77, PCB 126, PCB 169)

Chlorinated dibenzofurans

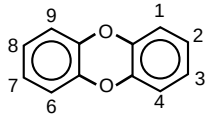
2,3,7,8-Tetrachlorodibenzofuran
1,2,3,7,8-Pentachlorodibenzofuran
2,3,4,7,8-Pentachlorodibenzofuran
1,2,3,4,7,8-Hexachlorodibenzofuran
1,2,3,6,7,8-Hexachlorodibenzofuran
2,3,4,6,7,8-Hexachlorodibenzofuran
1,2,3,7,8,9-Hexachlorodibenzofuran
1,2,3,4,6,7,8-Heptachlorodibenzofuran
1,2,3,4,7,8,9-Heptachlorodibenzofuran
Octachlorodibenzofuran



Dibenzofuran parent structure

Chlorinated dibenzodioxins

2,3,7,8-Tetrachlorodibenzo-p-dioxin
1,2,3,7,8-Pentachlorodibenzo-p-dioxin
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin
Oct achlorodibenzo-p-dioxin



Dibenzo-p-dioxin parent structure

TABLE 1 (cont.)

Organic contaminants, and major and trace elements determined as part of the NS&T Program.

(Number below chemical structure is the Chemical Abstracts Service registry number.)

Major and trace elements

Al	-	aluminum	Cu	-	copper	Ag	-	silver
Si	-	silicon	Zn	-	zinc	Cd	-	cadmium
Cr	-	chromium	As	-	arsenic	Hg	-	mercury
Mn	-	manganese	Se	-	selenium	Tl	-	thallium
Fe	-	iron	Sn	-	tin	Pb	-	lead
Ni	-	nickel	Sb	-	antimony			

Organotins

Monobutyltin^{3+}, dibutyltin^{2+}, tributyltin^{+}, tetrabutyltin

RESULTS AND DISCUSSION

Status

Oysters

Florida Panhandle Mussel Watch data were compared to the nationwide NS&T median and 85th percentile values. Concentrations above the 85th percentile are in the highest 15% of the data set and are used to indicate "high" concentrations. Percentiles are robust with regard to both outliers and concentrations below the detection limit. The NS&T medians and 85th percentiles are listed in Table 3.

Oysters and mussels are not equal in their ability to concentrate trace elements (O'Connor, 1993). The trace elements Ag, Cu, and Zn are concentrated to a greater extent by oysters relative to mussels. Conversely, Pb is concentrated at more than three times the level in the mussels than in the oysters. Therefore, only the NS&T oyster data were used to compare to the Ag, Cu, Pb and Zn Florida Panhandle oyster data. The differences in bioaccumulation between oysters and mussels for the other elements and the organic analytes are not sufficiently great as to prevent the combination of the data from the two bivalves.

The mean analyte concentrations in oysters collected in the Florida Panhandle were generally below the NS&T 85th percentile values. Most of the exceptions were found in Choctawhatchee Bay where mean annual concentrations above the NS&T 85th percentile values were found for Ag, Cu, Hg, Pb, Se, total chlordane pesticides, the sum of dieldrin and aldrin, total DDTs, total PCBs and total tributyltins. Values above the NS&T 85th percentile were also found in St. Andrews Bay for As, Cu, Pb, total chlordane pesticides, total DDTs, total PCBs and total tributyltins. The nation's highest total PAHs values for oysters determined as part of the NS&T Mussel Watch Project were found at the Watson Bayou (SAWB) site in St. Andrews Bay.

Sediment

In general, high levels of many NS&T analytes and aggregates in sediments were found at the Mussel Watch sites near high population densities. There are exceptions to this correlation with population for some

TABLE 2

NS&T sampling sites in Northern Florida.

Site	Site code	Latitude (N)	Longitude (W)	Years of tissue data*	Population[D] (20 km of site)
Mussel Watch Project					
Eastern oyster, Crassostrea virginica					
Pensacola Bay					
Public Harbor	PBPH	30° 30.41'	87° 87.19'	8	244339
Indian Bayou	PBIB	30° 30.52'	87° 87.11'	8	216268
Sabine Point	PBSP	30° 30.35'	87° 87.15'	3	191504
Choctawhatchee Bay					
Ben's Lake	CBBL	30° 30.45'	86° 86.54'	3	114324
Boggy Bayou	CBBB	30° 30.50'	86° 86.49'	3	107289
Postil Point	CBPP	30° 30.48'	86° 86.48'	11	107394
Joe's Bayou	CBJB	30° 30.41'	86° 86.49'	8	108740
Off Santa Rosa	CBSR	30° 30.41'	86° 86.20'	11	9977
St. Andrew Bay					
Little Oyster Bar	PCLO	30° 30.25'	85° 85.68'	7	115819
Municipal Pier	PCMP	30° 30.15'	85° 85.66'	6	113185
Watson Bayou	SAWB	30° 30.14'	85° 85.63'	10	111982
Apalachicola Bay					
Dry Bar	APDB	29° 29.68'	85° 85.07'	10	4835
Cat Point Bar	APCP	29° 29.72'	84° 84.88'	10	5840
Benthic Surveillance Project					
Atlantic croaker, Micropogonias undulatus, collected unless noted.					
Pensacola Bay					
Pensacola Bay‡	PENPB	30° 25.5'	87° 11.2'	-	247529
Choctawhatchee Bay					
Choctachatchee Bay	COCCB	30° 26.4'	86° 20.3'	-	-
Destin Harbor	COCDH	30° 23.4'	86° 29.8'	-	-
St. Andrew Bay					
Military Point	ANDMP	30° 07.6'	85° 38.0'	-	-
Apalachicola Bay					
St. George Island	APASG	29° 38.9'	84° 58.4'	-	6017

[D] 1990 Census.

* Years of tissue data available through 1997.

‡ Leistomus xanthurus (spot) collected in 1985 in PENPB and in 1984 at APASG.

TABLE 3

NS&T Mussel Watch Data medians and 85th percentile values (1986 - 1997)
(Medians and percentiles were determined using the average at each site across all sampled years. Element data in µg/g dry wt. unless noted, and organic data in ng/g dry wt.).

Oyster data only

	Cu	Zn	Ag	Pb
n	128	128	128	128
Median	140	2200	2.3	0.51
85th percentile	290	4600	5.0	0.82

Mussel and oyster data

	Ni	As	Se	Cd	Hg
n	281	281	281	281	280
Median	1.9	9.2	2.8	2.8	0.10
85th percentile	2.1	16	3.9	5.9	0.21

	ÂDDTs	ÂPCBs	ÂPAHs	ÂCdane	ÂDieldrin
n	280	280	268	280	280
Median	33	100	300	10	5.1
85th percentile	140	450	1200	32	15

	Mirex	Hexachloro-benzene	Lindane	Endrin	ÂBTs
n	280	280	280	45	250
Median	0.24	0.23	1.2	0.38	54
85th percentile	1.2	1.1	2.8	2.3	200

Sediment data (Calculated using Mussel Watch Project sediment data only.)

	Al (%)	Si (%)	Cr	Mn	Fe (%)
n	223	178	222	199	223
Median	2.4	3.0	54	370	2.1
85th percentile	4.8	36	120	740	3.7

	Ni	Cu	Zn	As	Se
n	223	223	223	223	207
Median	17	14	67	6.9	0.38
85th percentile	36	47	130	12	0.74

	Ag	Cd	Sn	Sb	Hg
n	223	223	223	178	223
Median	0.11	0.19	1.3	0.47	0.057
85th percentile	0.59	0.56	3.1	1.8	0.22

TABLE 3 (cont.)

	Tl	Pb	TOC (%)	ÂDDTs	ÂPCBs
n	145	223	220	224	224
Median	0.073	18	1.0	2.9	15
85th percentile	0.56	40	2.4	18	80

	ÂPAHs	ÂCdane	ÂDieldrin	Mirex
n	224	224	224	224
Median	380	0.51	0.30	0.002
85th percentile	2300	3.1	1.9	0.36

	Hexachloro-benzene	Lindane
n	223	224
Median	0.14	0.04
85th percentile	0.92	0.47

ÂDDTs: The sum of concentrations of DDTs and its metabolites, DDEs and DDDs.
ÂPCBs: The sum of the concentrations of homologs, which is approximately twice the sum of the 18 congeners.
ÂPAHs: The sum of concentrations of the 18 PAH compounds.
ÂCdane: The sum of cis-chlordane, trans-nonachlor, heptachlor, and heptachlor epoxide.
ÂDieldrin: The sum of dieldrin and aldrin.
ÂBTs: The sum of the concentrations of tributyltin and its breakdown products dibutyltin and monobutyltin (as ng Sn/g dry wt.).
n: Number of data points (roughly equivalent to the number of sampling sites).

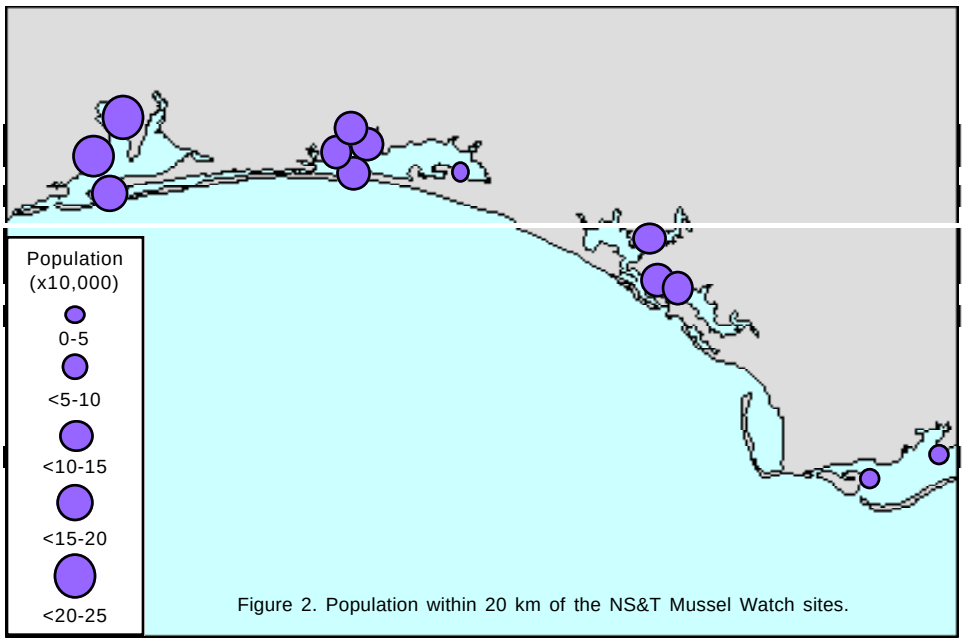


Figure 2. Population within 20 km of the NS&T Mussel Watch sites.

TABLE 4

Temporal trends in chemical concentrations measured nationally at 186 Mussel Watch Project sites and at ten Florida Panhandle area sites (APCP, APDB, CBJB, CBPP, CBSR, PBIB, PBPH, PCLO, PCMP, SAWB) for which data exist for the years 1986-1997.

	Trend				Trend		
Aggregated chemicals*	I	D	NT	Element	I	D	NT
ÂCdane	1	81 (5)	104	As	11	11	164
ÂDDTs	1	38 (4)	147	Cd	3	28	155
ÂDield	1	32 (3)	153	Cu	7	14	165
ÂPCBs	1	37 (2)	148	Hg	7	9 (1)	170
ÂPAHs	3	3 (2)	180	Ni	6	8	172
ÂBTs	0	18	168	Pb	14	9	163
				Se	8	9	169
				Zn	7	9	170

I - Increasing, D - Decreasing, NT - No trend. Increasing and decreasing trends for the Florida Panhandle are given in parentheses.
* Individual organic compound concentrations have been aggregated into these groups:
ÂDDTs: The sum of concentrations of DDTs and its metabolites, DDEs and DDDs.
ÂCdane: The sum of cis-chlordane, trans-nonachlor, heptachlor and heptachlor epoxide.
ÂPCBs: The sum of the concentrations of di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, and nonachlorobiphenyls.
ÂPAHs: The sum of concentrations of the 18 PAH compounds.
ÂBTs: The sum of the concentrations of tributyltin and its breakdown products dibutyltin and monobutyltin (as tBT/g dry wt.).

pesticides probably resulting from agricultural use. Values above the NS&T 85th percentile for sediment were found for Cr at Choctawhatchee Bay; Mn at Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays; Ni at Choctawhatchee Bay; Cu at Choctawhatchee and St. Andrews Bays; Zn at Pensacola, Choctawhatchee and St. Andrews Bays; As at Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays; Se at Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays; Ag at Choctawhatchee Bay; Cd at Choctawhatchee Bay; Sn at Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays; Hg at Pensacola, Choctawhatchee and St. Andrews Bays; Pb at Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays; total PCBs at Pensacola, Choctawhatchee and St. Andrews Bays; total PAHs at Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays; total DDTs at Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays; total chlordane pesticides at Pensacola, Choctawhatchee, St. Andrews and Apalachicola Bays; dieldrin and aldrin at Choctawhatchee and St. Andrews Bays; hexachlorobenzene at Choctawhatchee Bay; lindane at Choctawhatchee and St. Andrews Bays; and mirex at Choctawhatchee, St. Andrews and Apalachicola Bays.

Trends

The levels of many analytes (i.e., Ni, As, Se, Cd, lindane, hexachlorobenzene and others) measured by the NS&T Program in oysters collected in the four Florida Panhandle estuaries were mostly below the 85th percentile with exceptions of high values during one or two years but displaying no regular increasing or decreasing pattern.

The following analytes and aggregates were above or mostly above the NS&T 85th percentile values.

Pensacola Bay: ÂPAHs, dieldrin and aldrin at Public Harbor (PBPH)

Choctawhatchee Bay: Cu, Zn, Hg, Pb, ÂPAHs, mirex, dieldrin and aldrin and ÂBTs at Joe's Bayou (CBJB); Ag and Pb at Boggy Bayou (CBBB); Ag, Hg, Pb, ÂPCBs, ÂDDTs and ÂCdane at Postil Point (CBPP); Pb at Ben's Lake (CBBL); Hg and Pb at Boggy Bayou (CBBB); and ÂPAHs at off Santa Rosa (CBSR).

St. Andrews Bay: Cu, Zn, As, Pb, ÂPAHs, ÂDDTs, total chlordane pesticides, and ÂBTs at Watson Bayou (SAWB); Cu, as, ÂPAHs and ÂBTs at Municipal Pier (PCMP); and ÂDDTs at Little Oyster Bar (PCLO).

Apalachicola Bay: ÂPAHs and mirex at Dry Bar (APDB); and mirex at Cat Point Bar (APCB).

CONCLUSIONS

Some of the highest levels of total PAHs in oysters collected as part of the NS&T Program were found at Watson Bayou (SAWB) in St. Andrews Bay. In addition, many other NS&T analytes and aggregates were also high at this site and at the Municipal Pier (PCMP). No obvious source of contamination was noted during sample collection.

High values for many analytes and aggregates were also found at the Postil Point (CBPP) and Joe's Bayou (CBJB) sites in Choctawhatchee Bay. These values may be related to military activities in the area.

ACKNOWLEDMENTS

The authors wish to thank the numerous chemists at the NOAA National Marine Fisheries Service and Texas A&M University (TAMU/GERG)

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NS&T DATA AND INFORMATION PRODUCTS

Data and information resulting from CCMA activities are made available to users and the scientific community at large in different formats and media.

NOAA Technical Memoranda provide detailed accounts of methods, data summaries, and results of various NS&T Program projects and related activities, such as sediment toxicity surveys, analytical methods, and sediment quality assessments.

Digitized data and program information about the NS&T program are available via electronic mail. Presently, data from the Mussel Watch Project (1984-1994) and the Benthic Surveillance Project (1984-1992) can be retrieved by downloading from the NCCOS Information Service which can be accessed at (http://ccmaserver.nos.noaa.gov). New data sets are added to the Service as they are digitized and checked for accuracy. The data sets can also be requested from CCMA.

Scientific publications containing the results of CCMA projects are published as research papers in journals, books, and proceedings of professional conferences. The publications are authored by CCMA staff, contractors, and collaborators. A cumulative list of these publications is issued periodically.

NS&T Mussel Watch sampling site at Postil Point, Choctawhatchee Bay (TAMU/GERG)

For further information on the NS&T Program or to obtain a list of available publications, write:

Oyster shells (TAMU/GERG)

Dr. Adriana Y. Cantillo
National Status and Trends Program
NOAA/NOS/NCCOS/CCMA
1305 East/West Highway
Silver Spring, MD 20910

Phone: 301 713 3028
Fax: 301 713 4388

APPENDICES

Appendix I
Sediment data

Appendix II
Trace element and organic trends in oysters

Appendix I

Sediment data

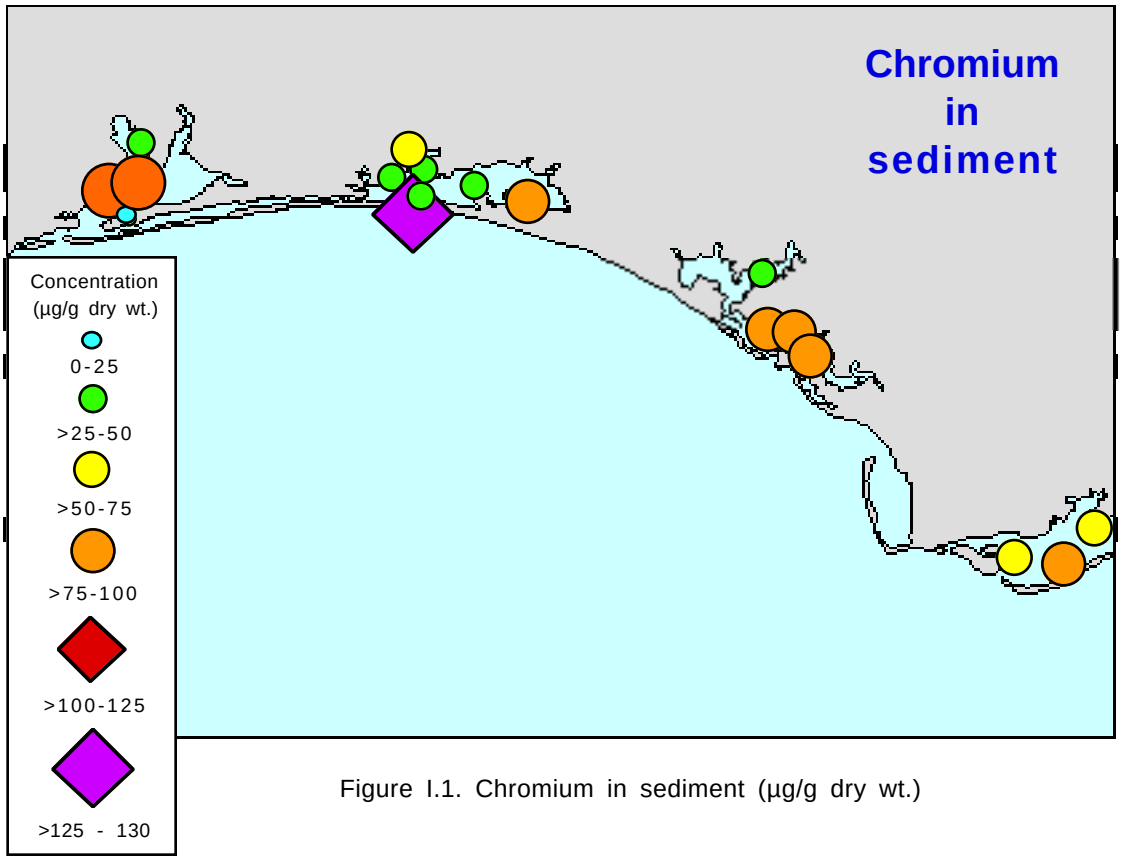


Figure I.1. Chromium in sediment (µg/g dry wt.)

NS&T Mussel Watch sampling site at Cat Point Bar, Apalachicola Bay (TAMU/GERG)

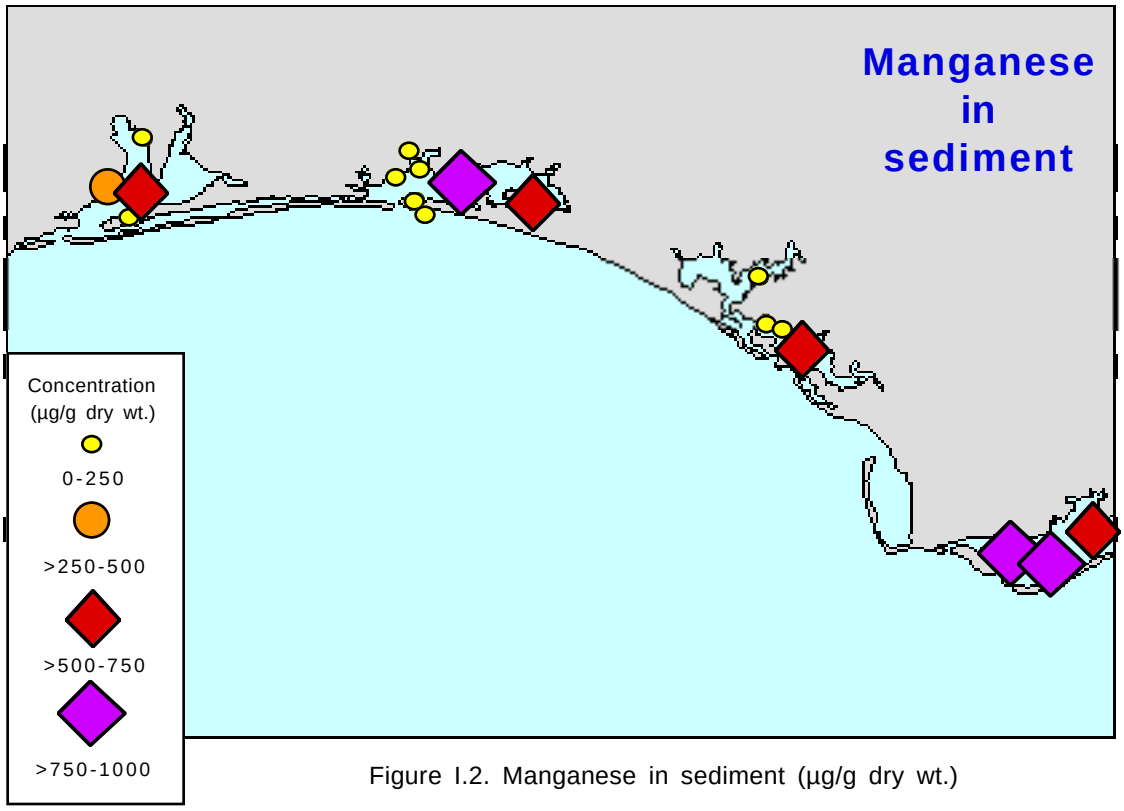


Figure I.2. Manganese in sediment (µg/g dry wt.)

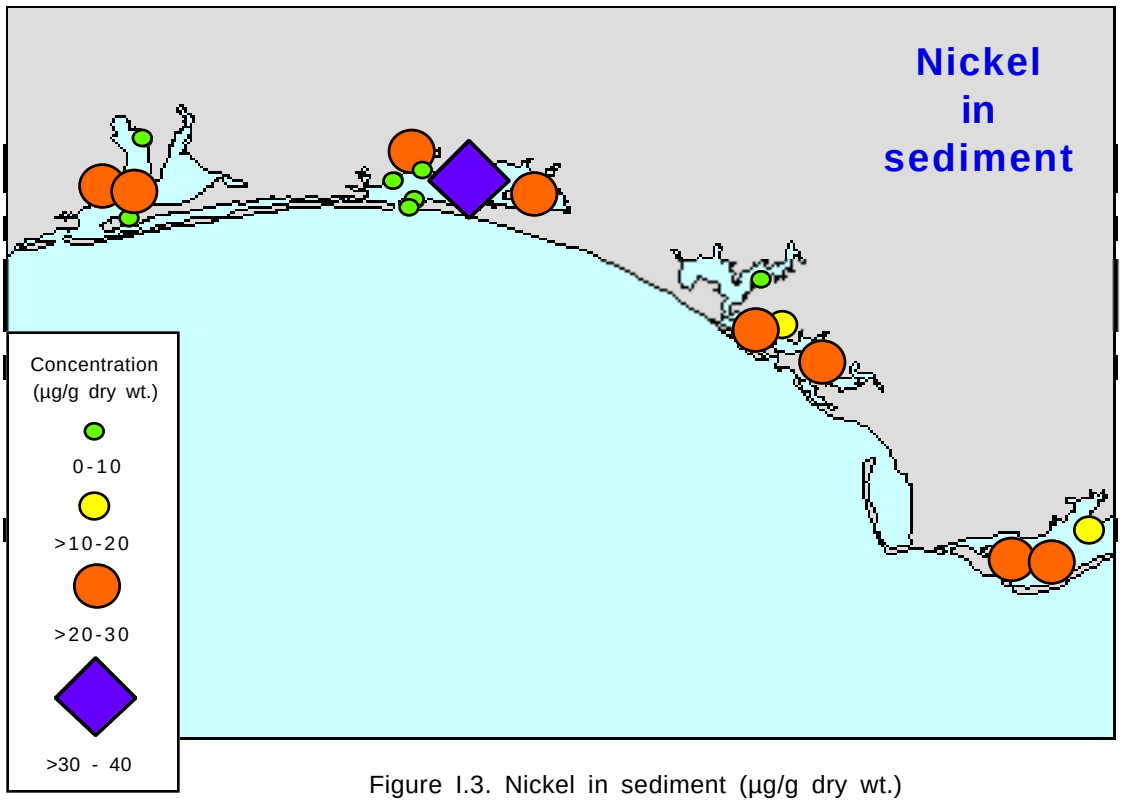


Figure I.3. Nickel in sediment (µg/g dry wt.)

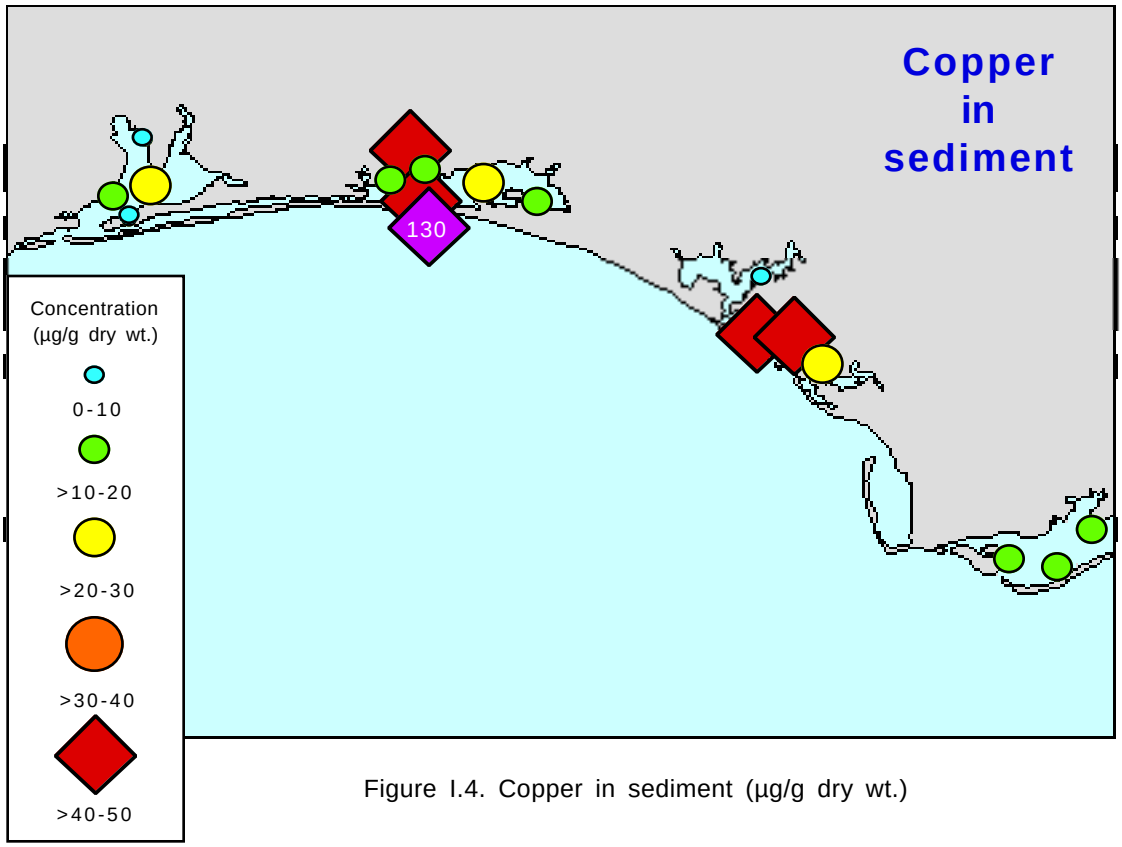


Figure I.4. Copper in sediment (µg/g dry wt.)

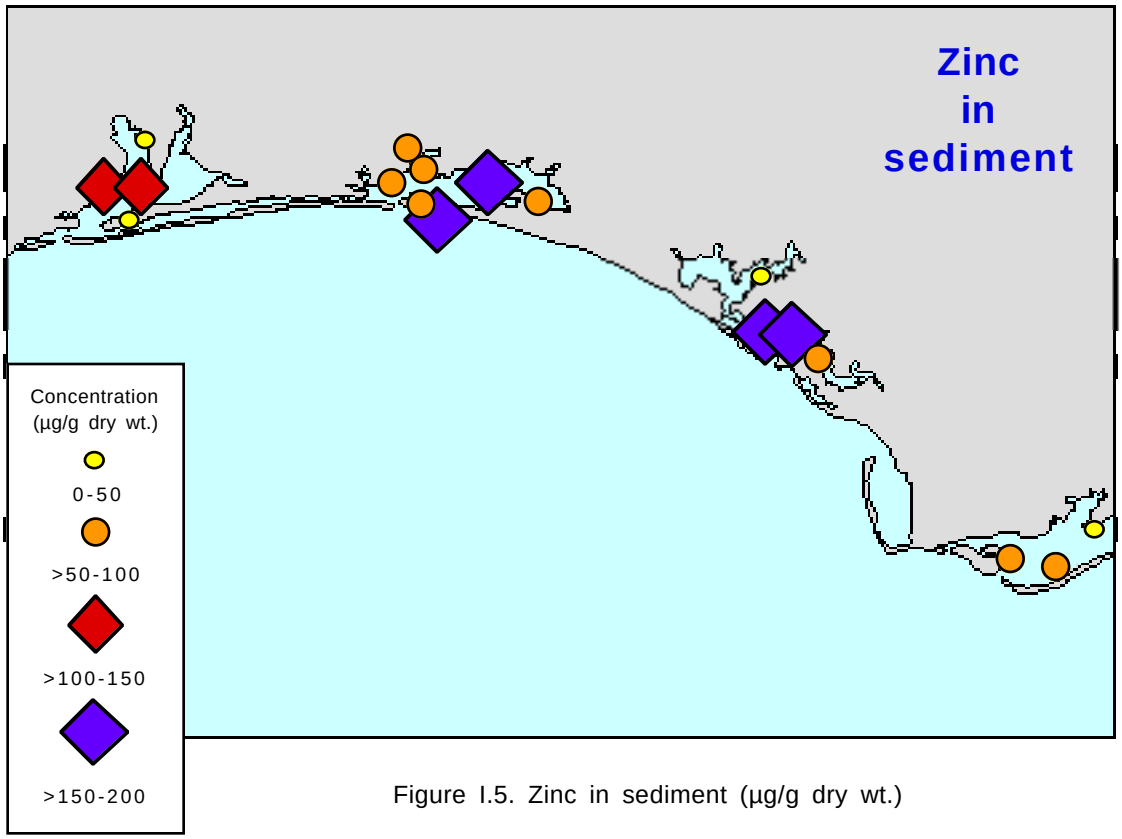


Figure I.5. Zinc in sediment (µg/g dry wt.)

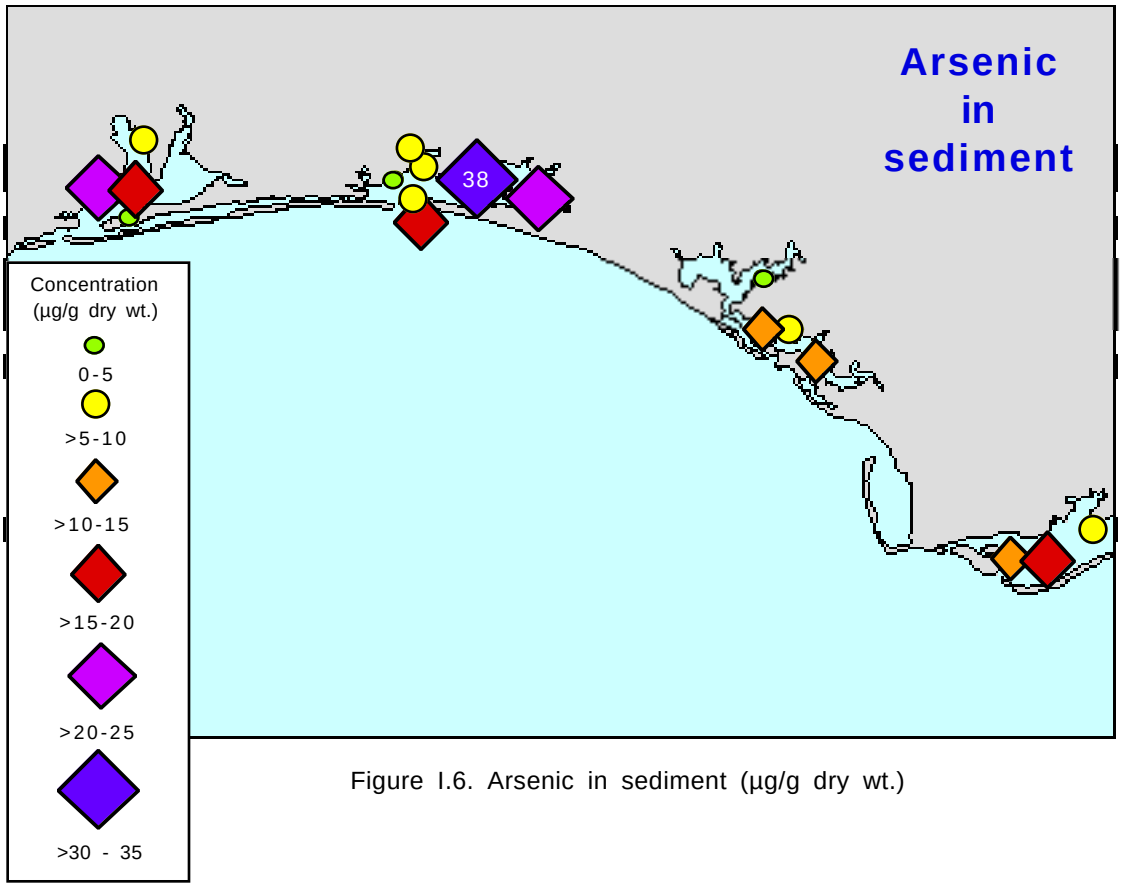
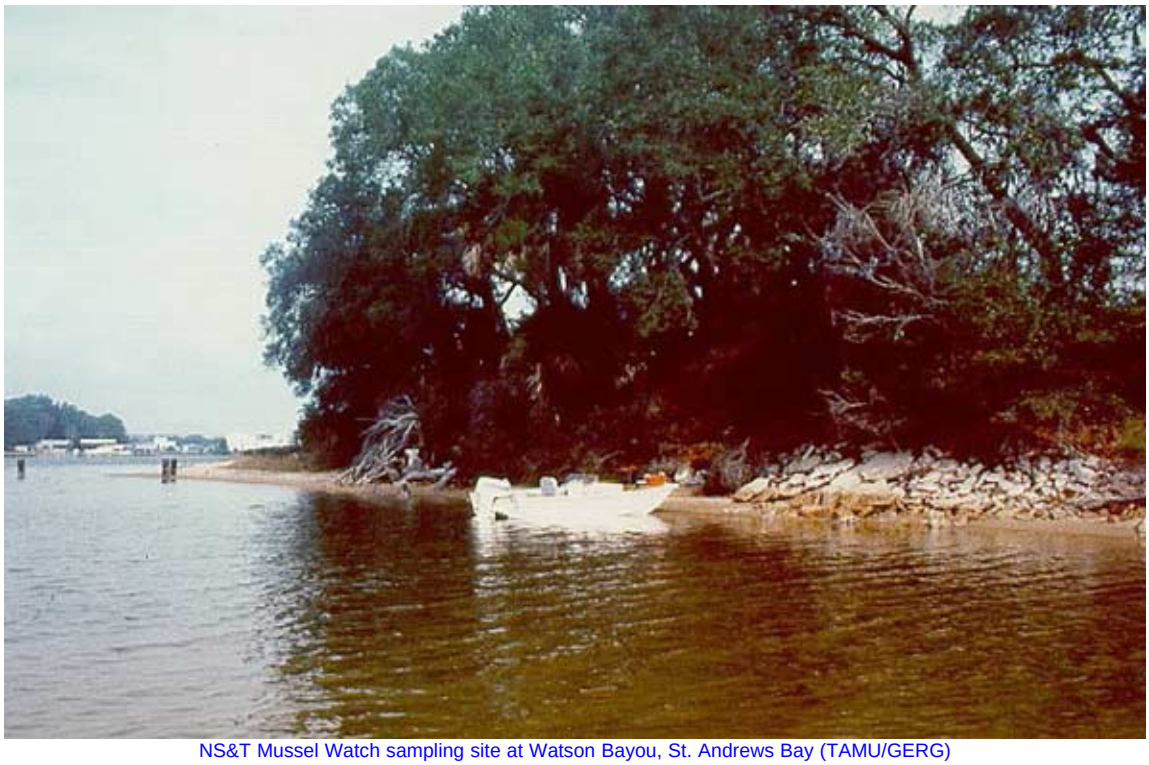


Figure I.6. Arsenic in sediment (µg/g dry wt.)



NS&T Mussel Watch sampling site at Watson Bayou, St. Andrews Bay (TAMU/GERG)

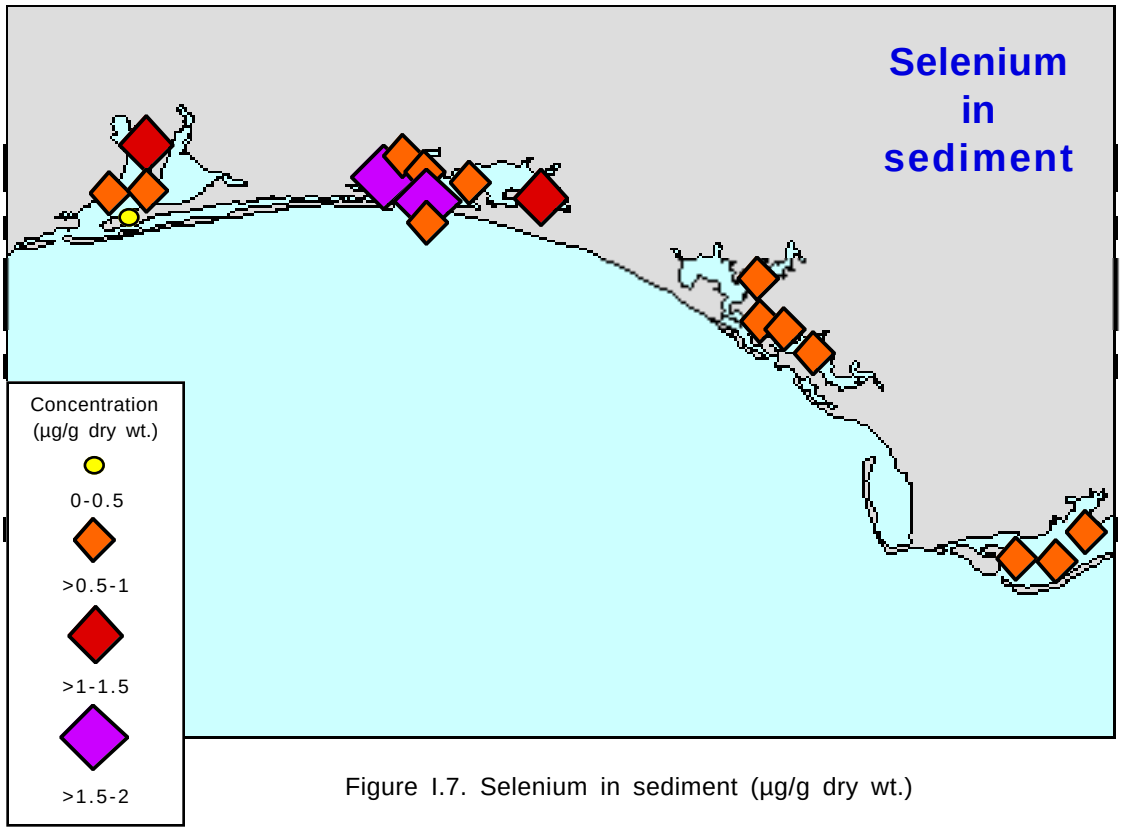


Figure I.7. Selenium in sediment (µg/g dry wt.)

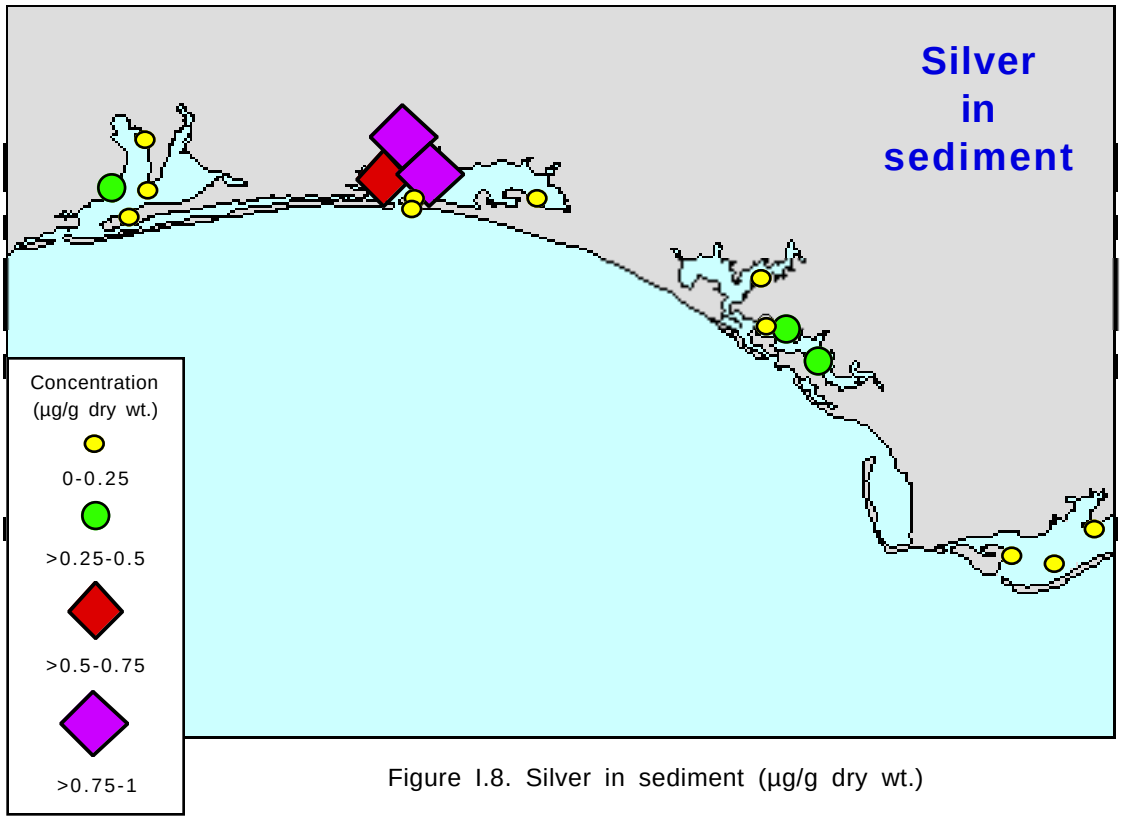


Figure I.8. Silver in sediment (µg/g dry wt.)

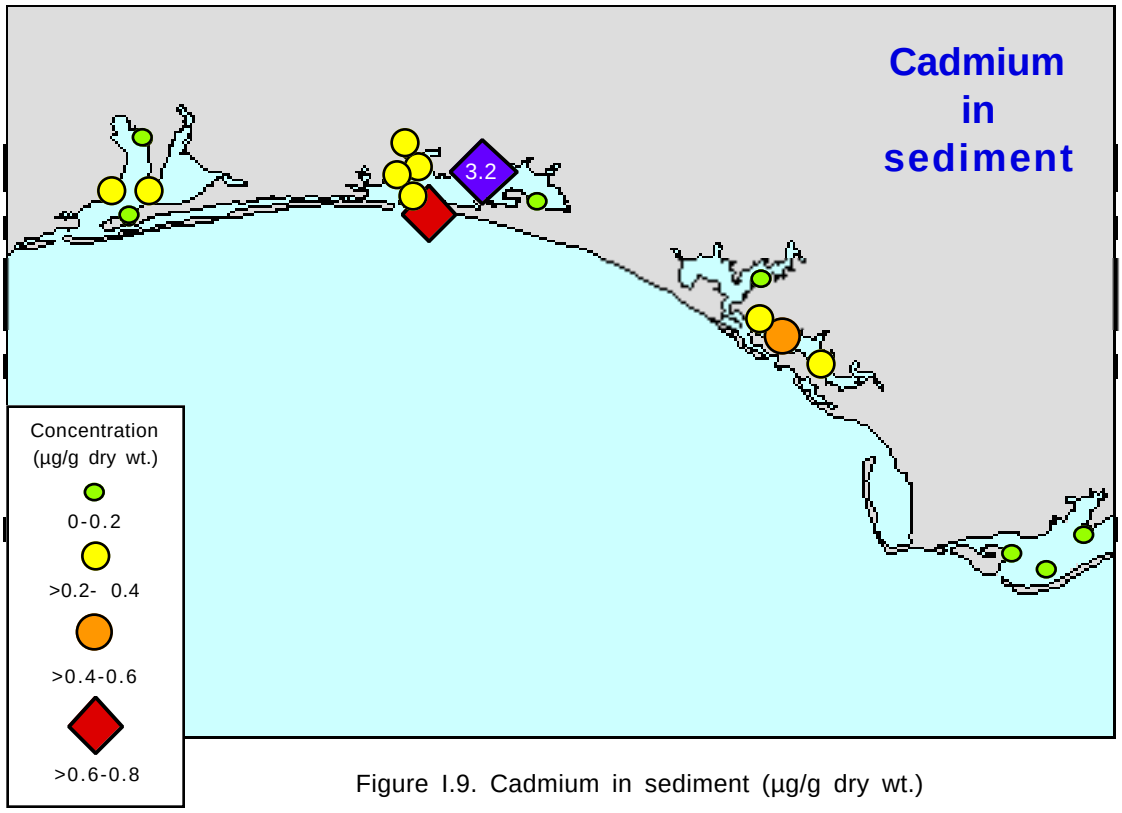


Figure I.9. Cadmium in sediment (µg/g dry wt.)

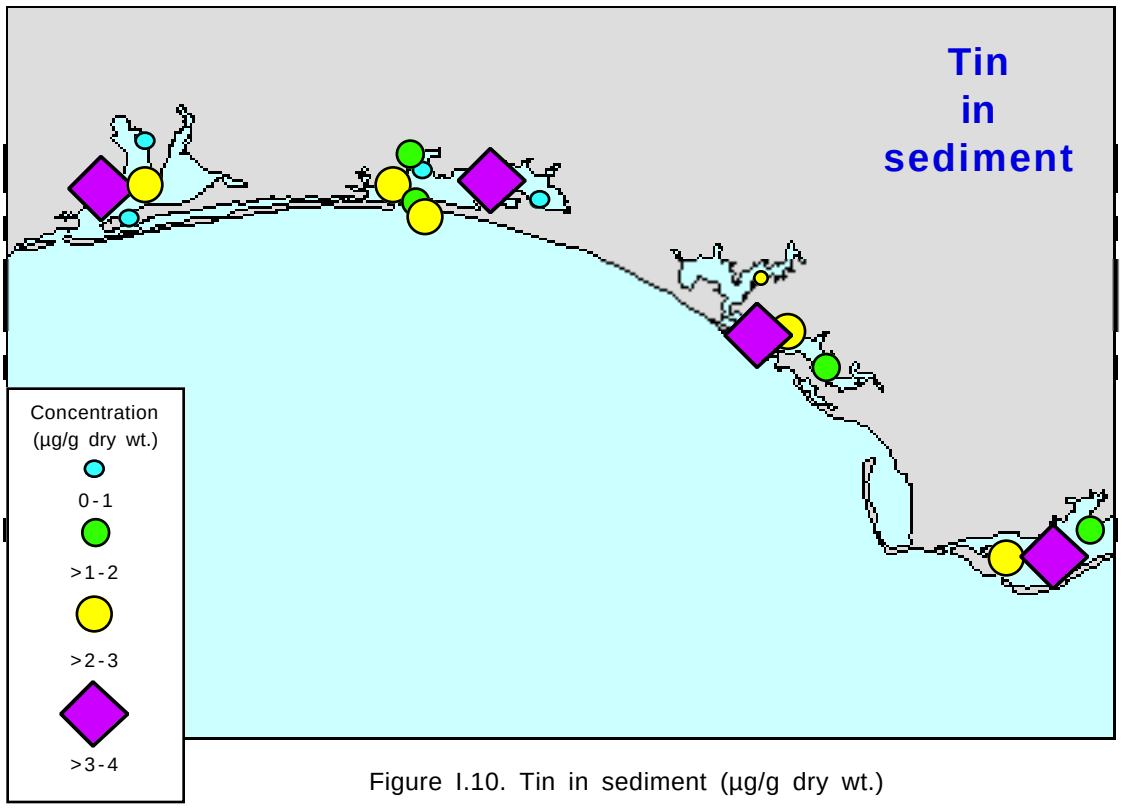


Figure I.10. Tin in sediment (µg/g dry wt.)

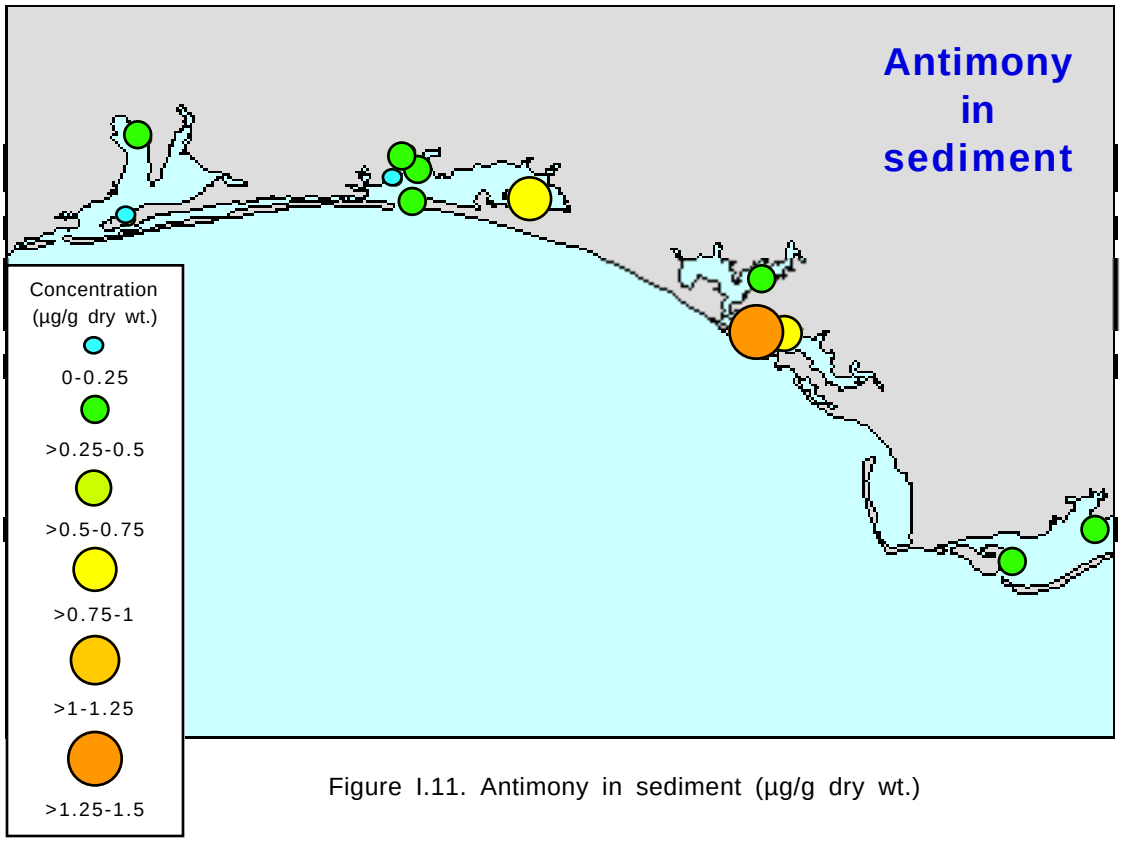


Figure I.11. Antimony in sediment (µg/g dry wt.)

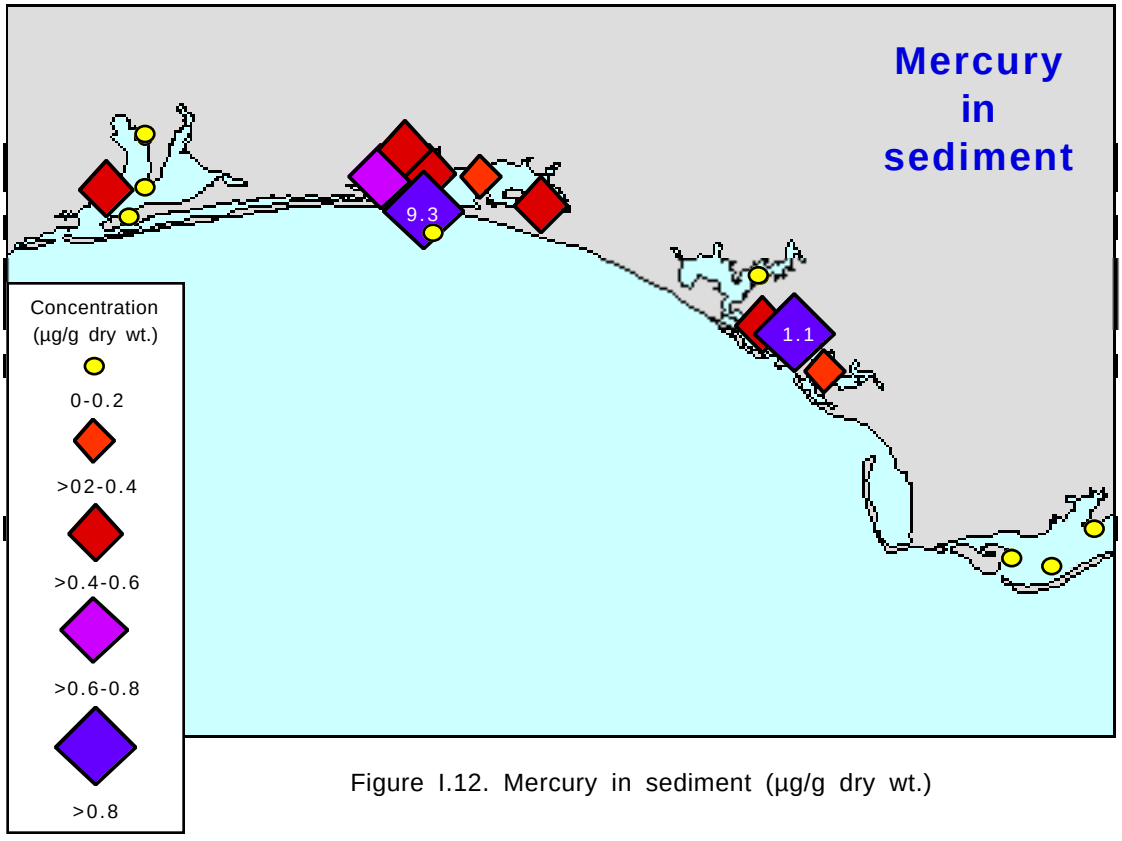


Figure I.12. Mercury in sediment (µg/g dry wt.)

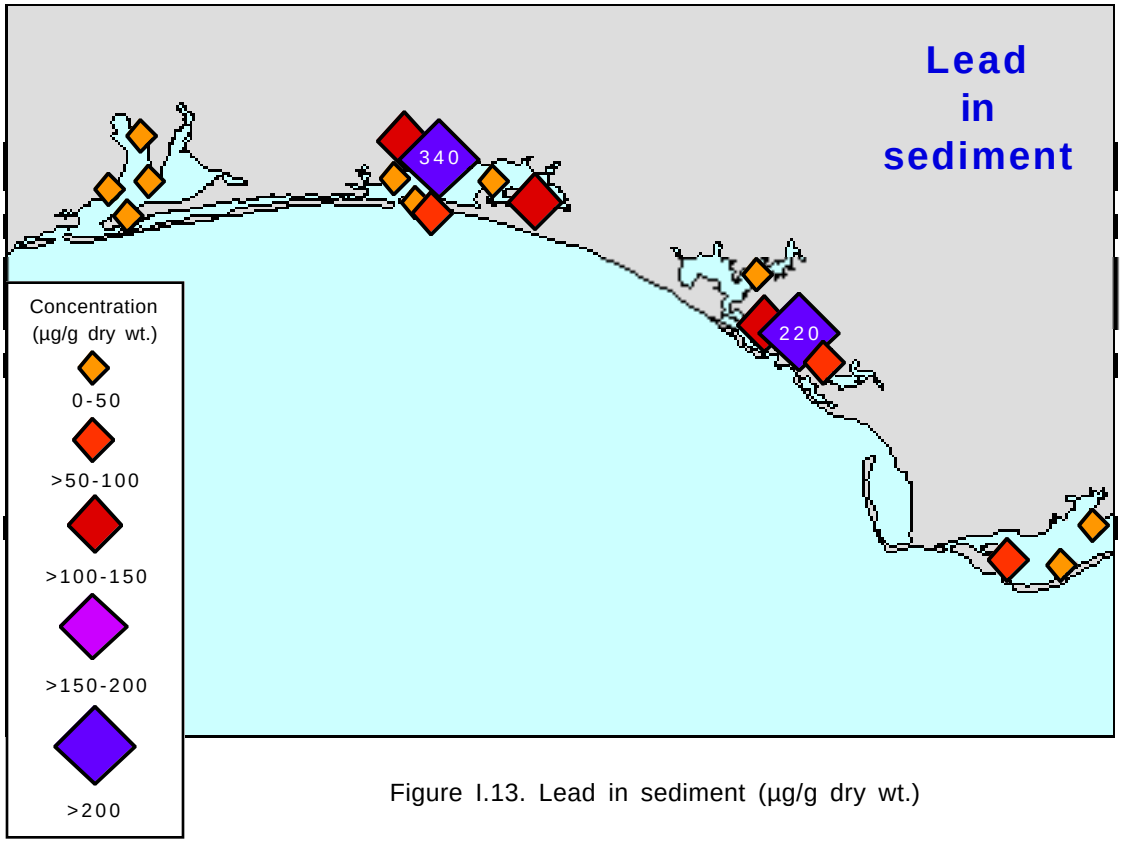


Figure I.13. Lead in sediment (µg/g dry wt.)

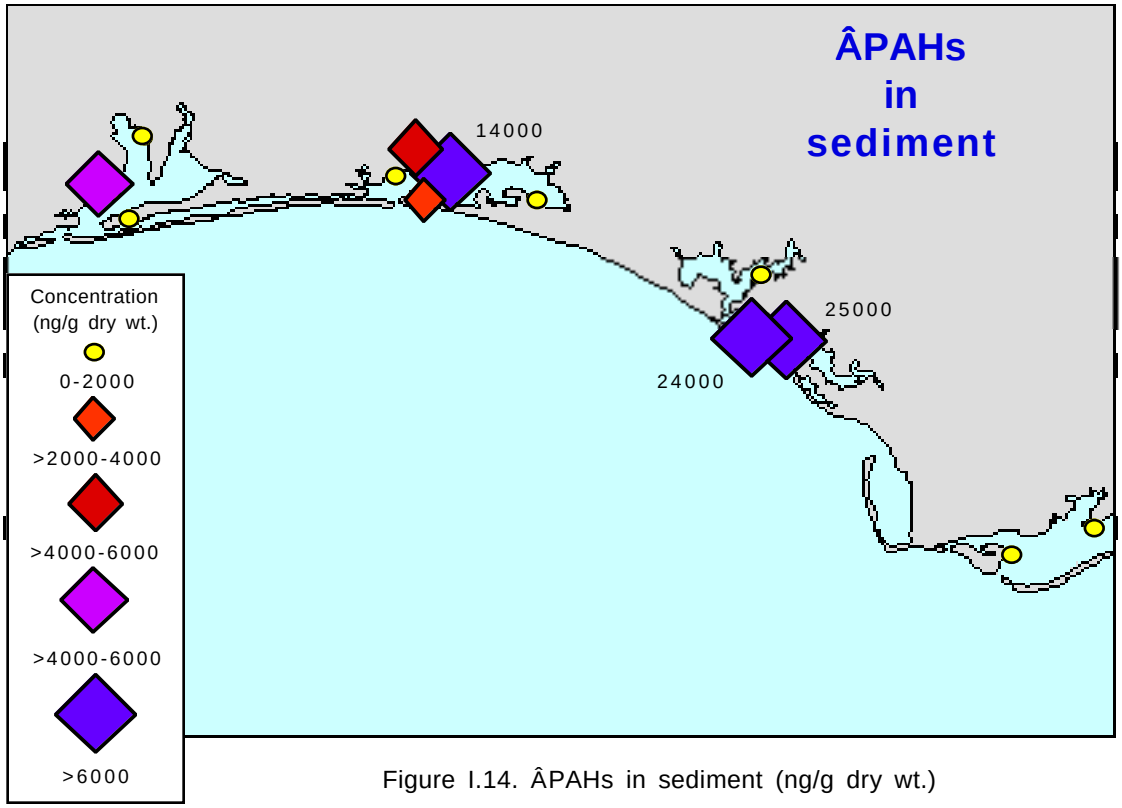


Figure I.14. ÂPAHs in sediment (ng/g dry wt.)

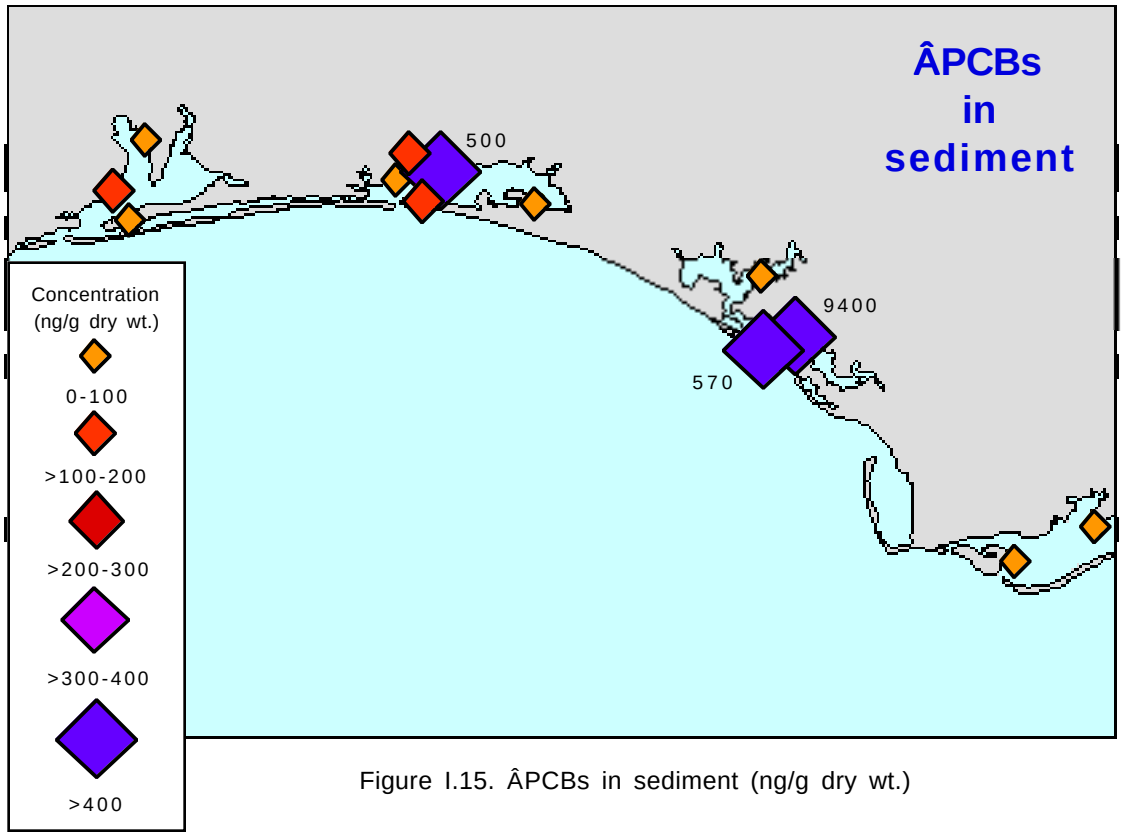


Figure I.15. ÂPCBs in sediment (ng/g dry wt.)

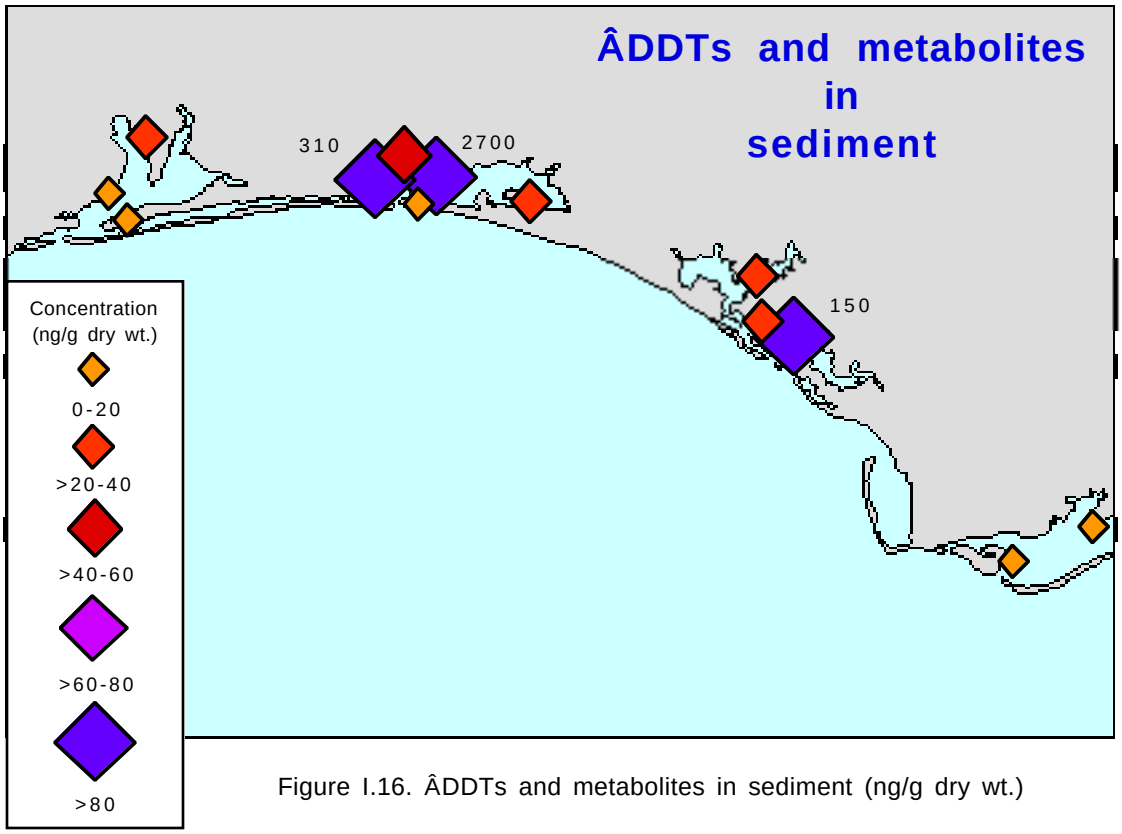


Figure I.16. ÂDDTs and metabolites in sediment (ng/g dry wt.)

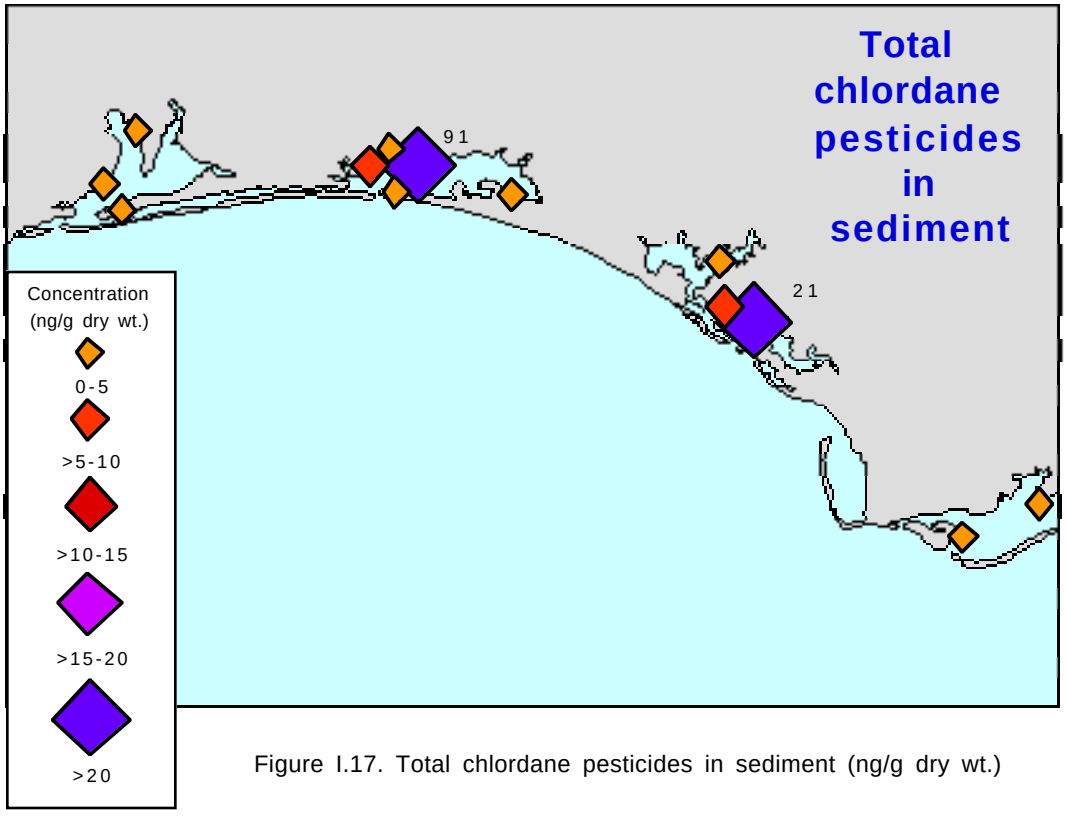


Figure I.17. Total chlordane pesticides in sediment (ng/g dry wt.)

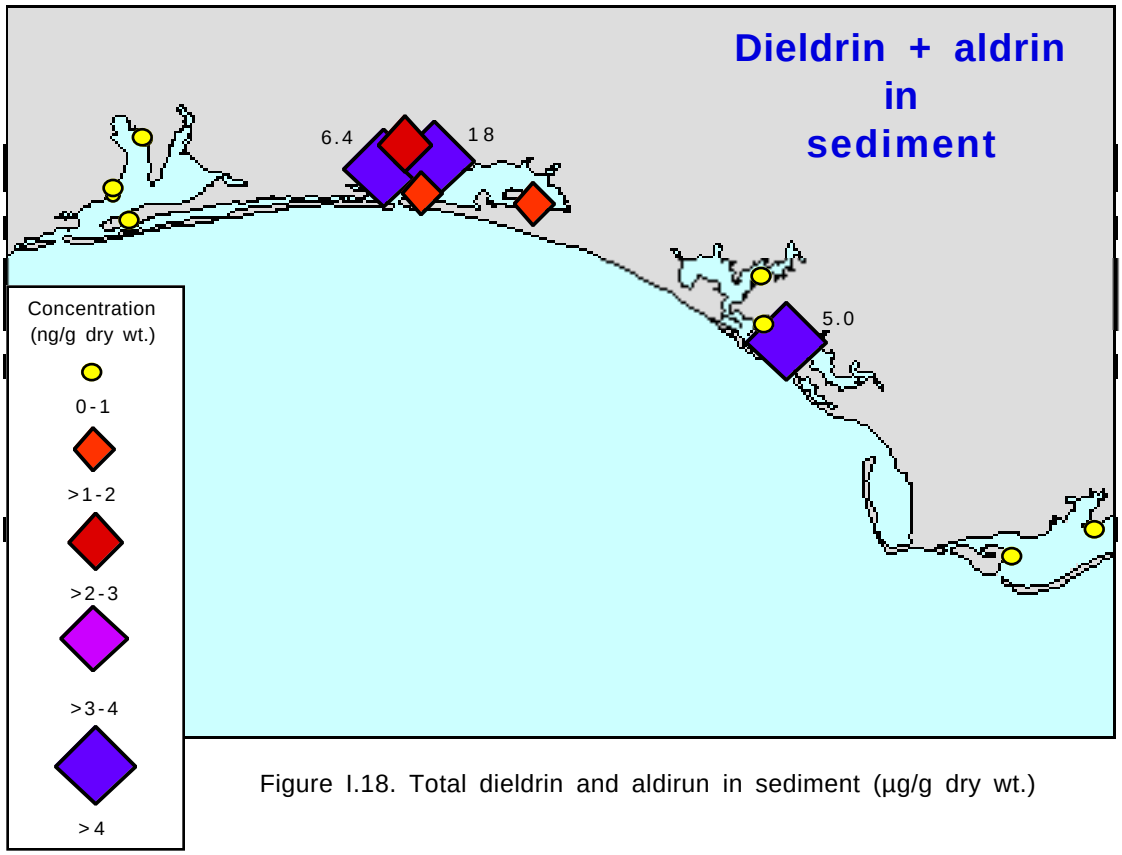


Figure I.18. Total dieldrin and aldirun in sediment (µg/g dry wt.)

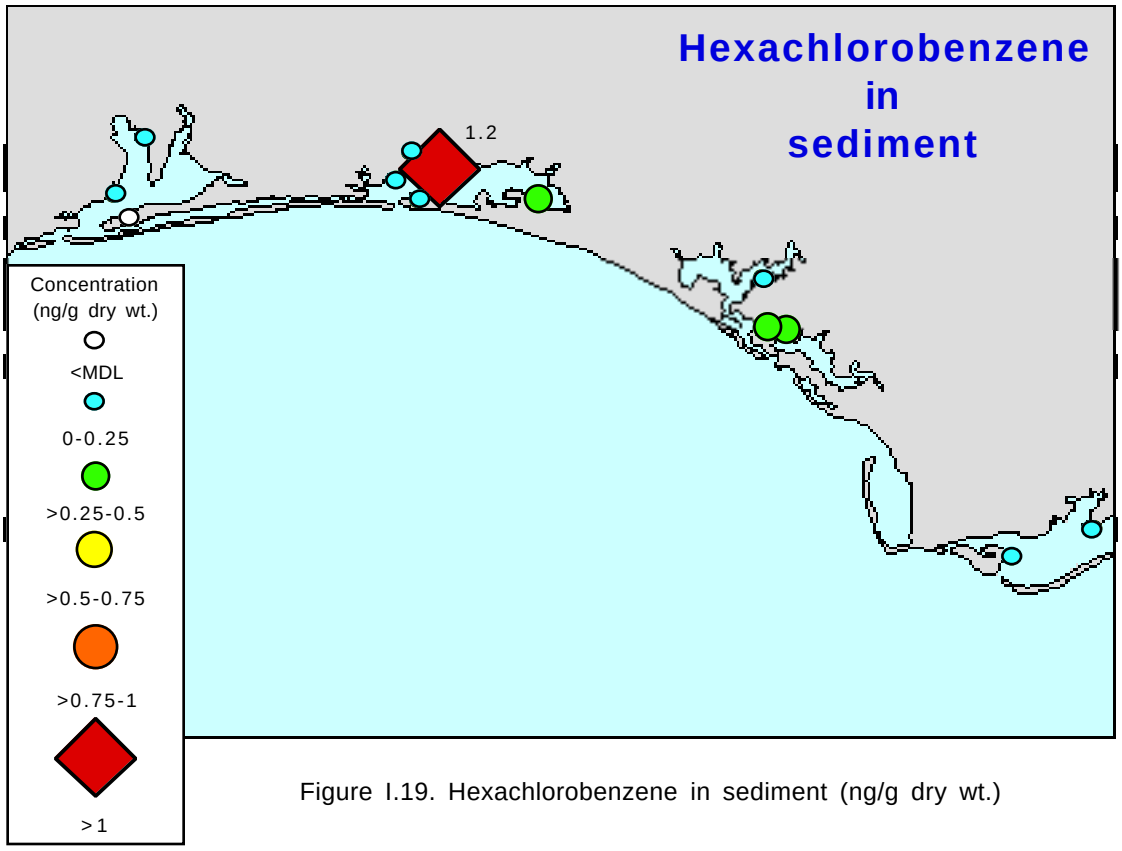


Figure I.19. Hexachlorobenzene in sediment (ng/g dry wt.)

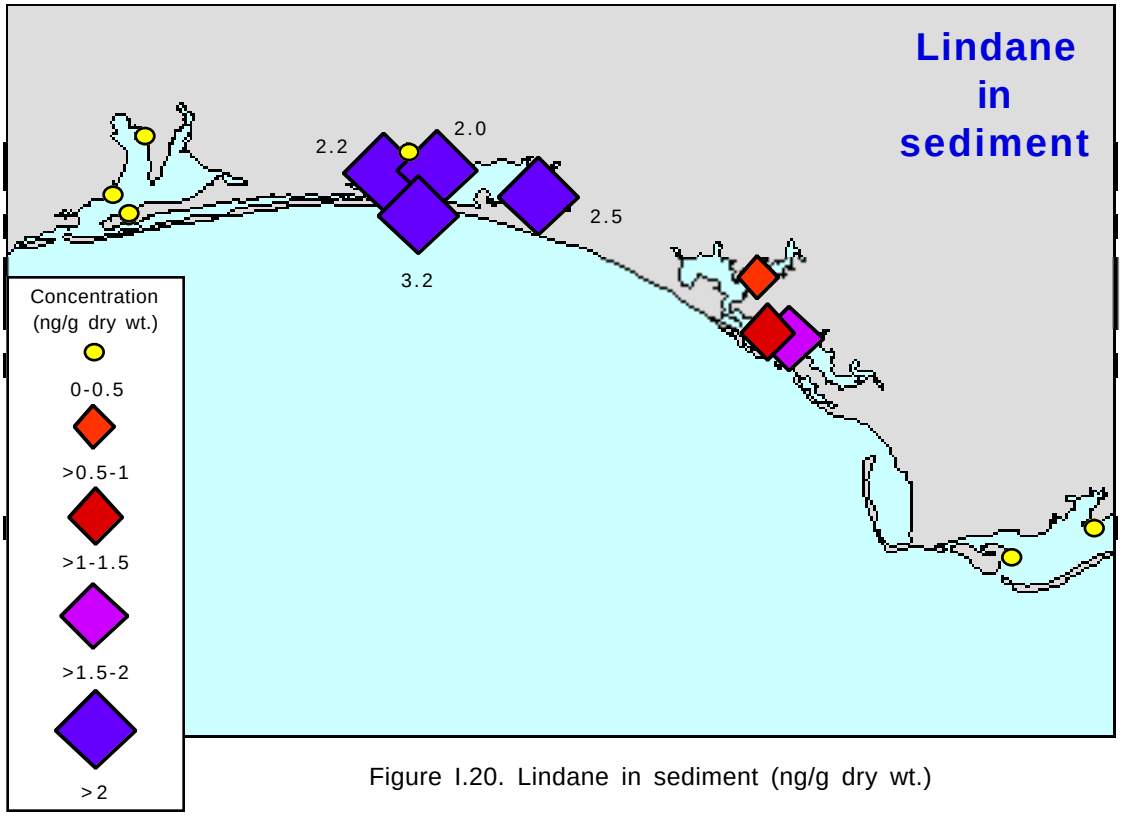


Figure I.20. Lindane in sediment (ng/g dry wt.)

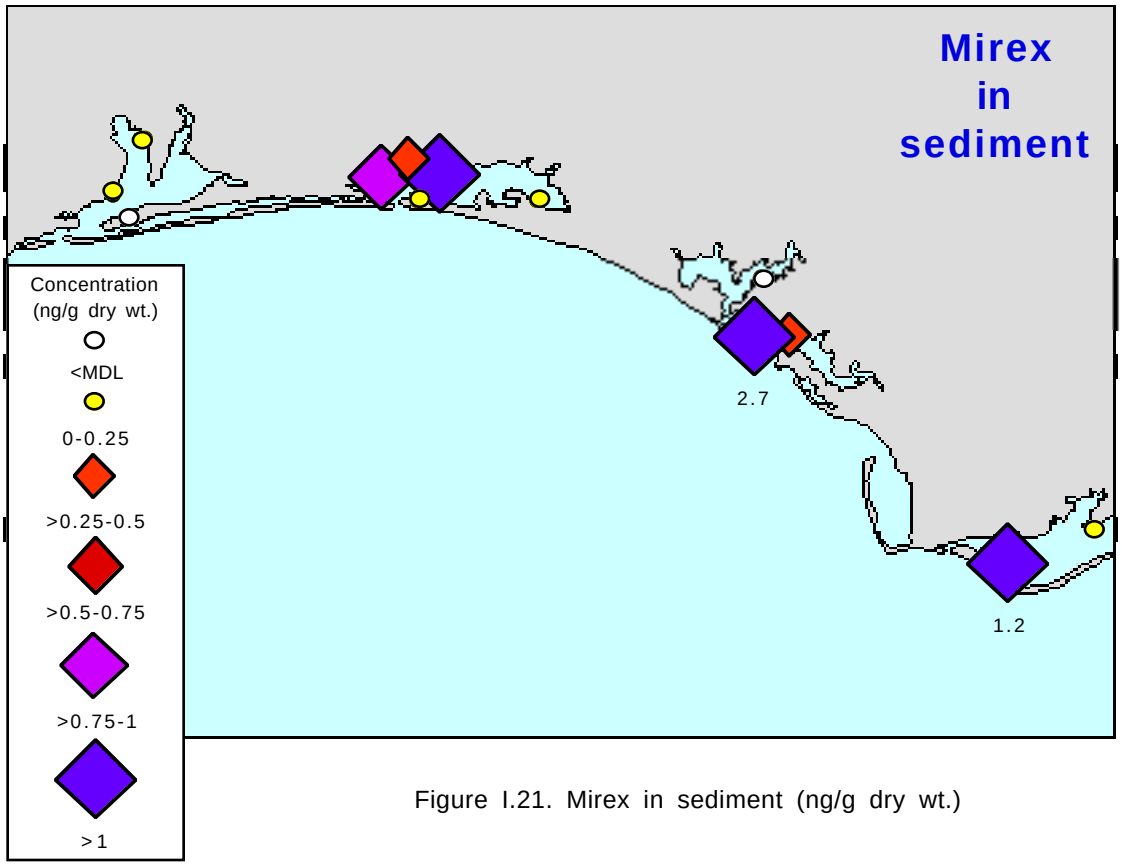


Figure I.21. Mirex in sediment (ng/g dry wt.)

NS&T Mussel Watch sampling site at the Municipal Pier, St. Andrews Bay (TAMU/GERG)

NS&T Mussel Watch sampling site at Joe's Bayou, Choctawhatchee Bay (TAMU/GERG)

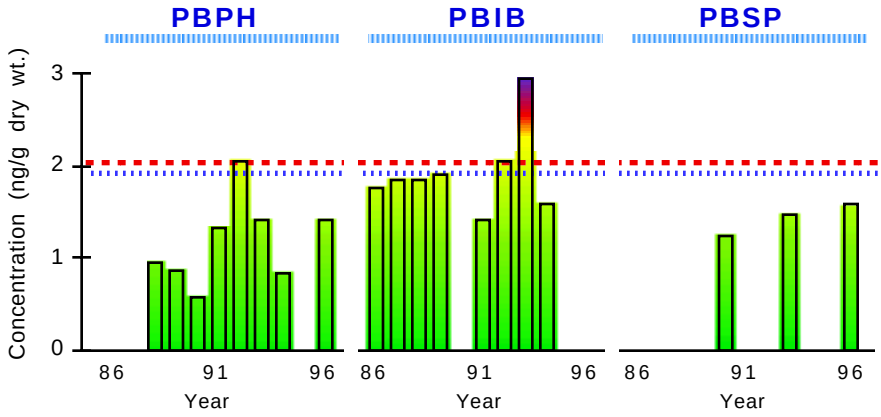
Sediment sampling(TAMU/GERG)

Appendix II

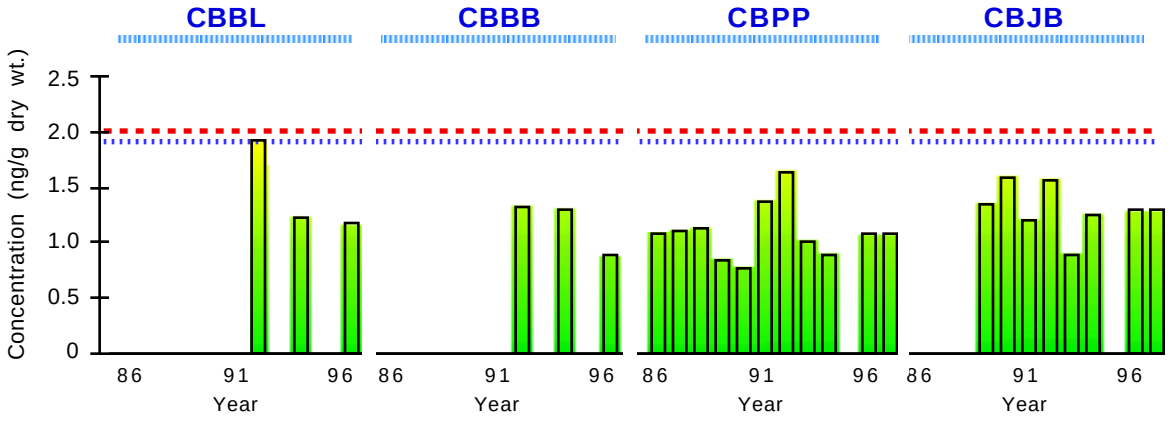
Trace element and organic trends in oysters

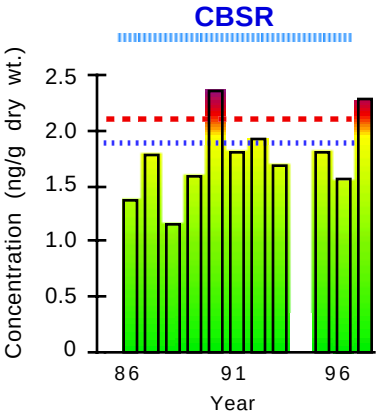
Nickel in oysters

Pensacola Bay



Choctawhatchee Bay





Nickel in oysters

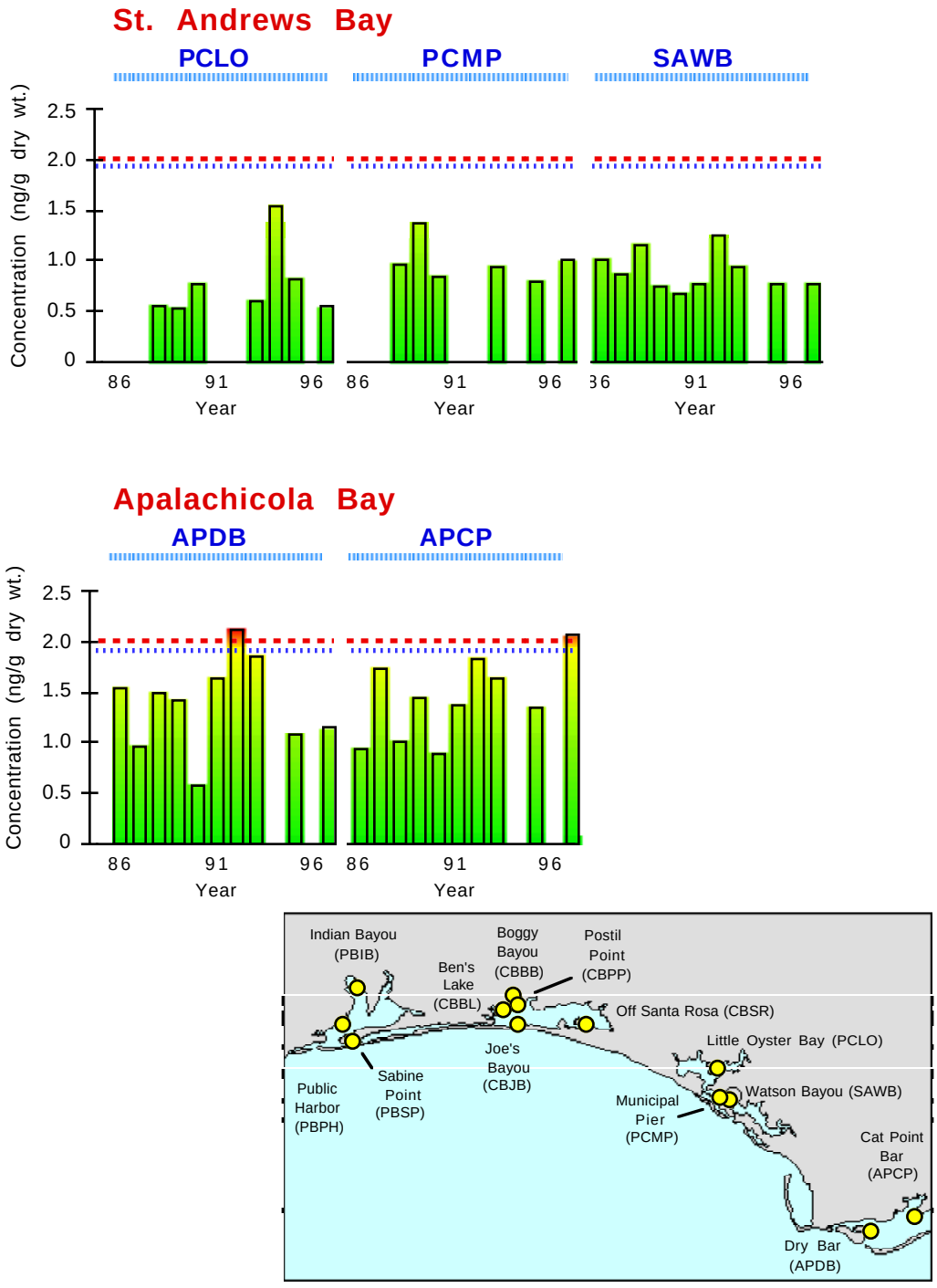
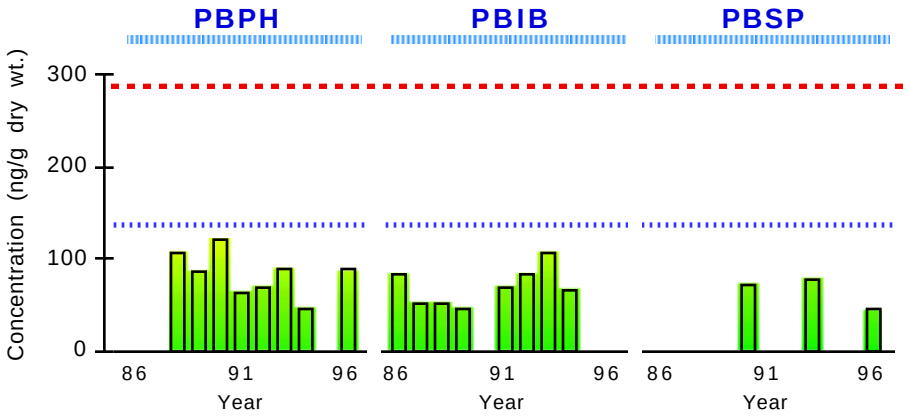


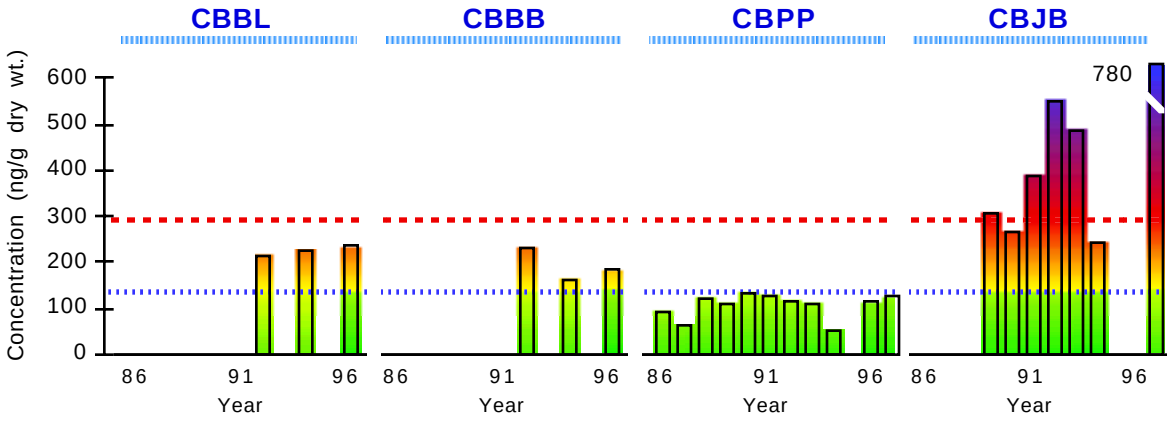
Figure II.1. Nickel trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

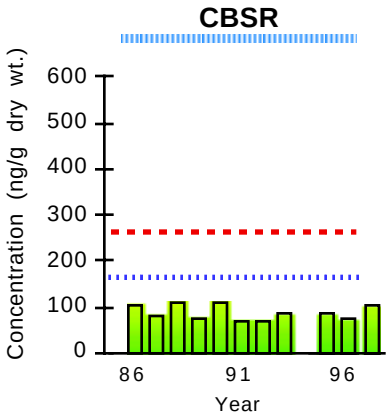
Copper in oysters

Pensacola Bay



Choctawhatchee Bay





Copper in oysters

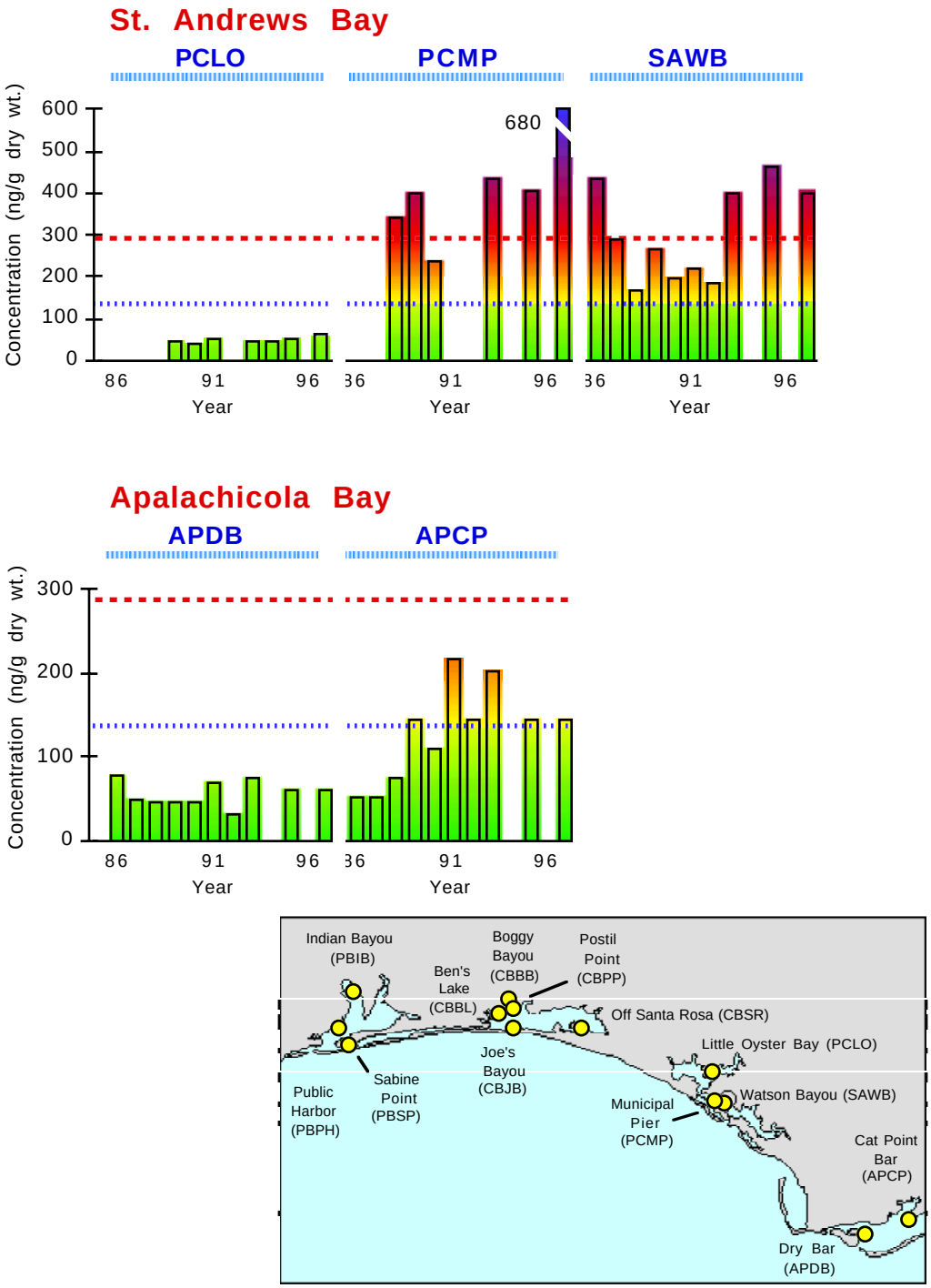
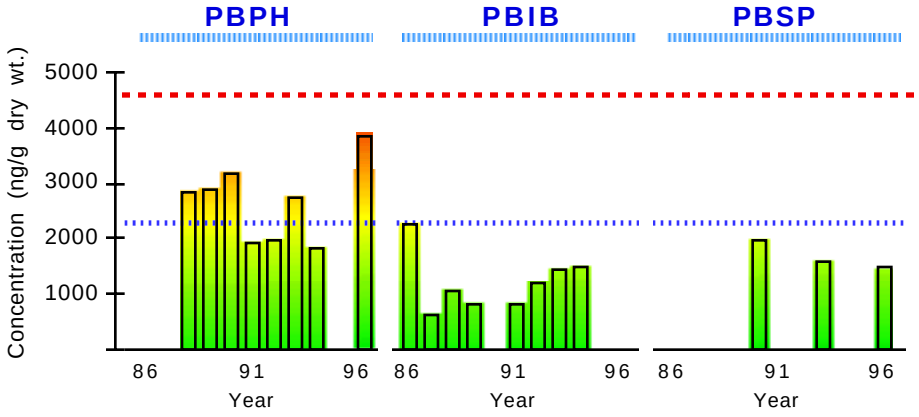


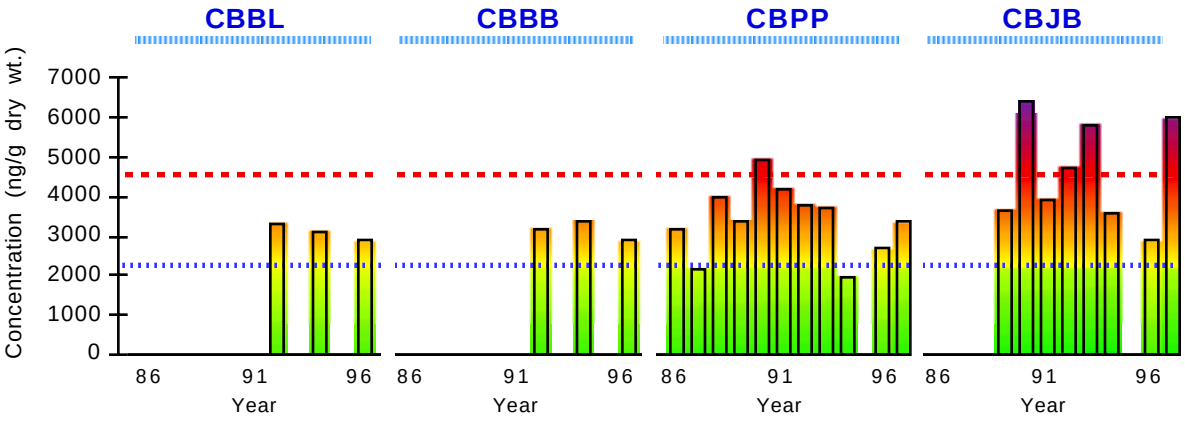
Figure II.2. Copper trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

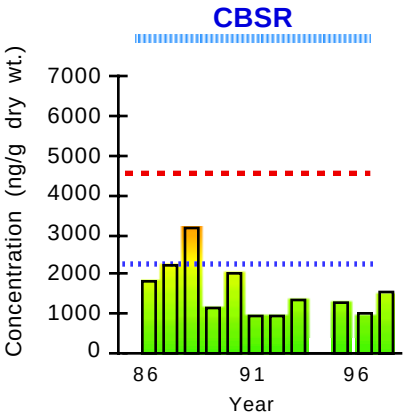
Zinc in oysters

Pensacola Bay



Choctawhatchee Bay





Zinc in oysters

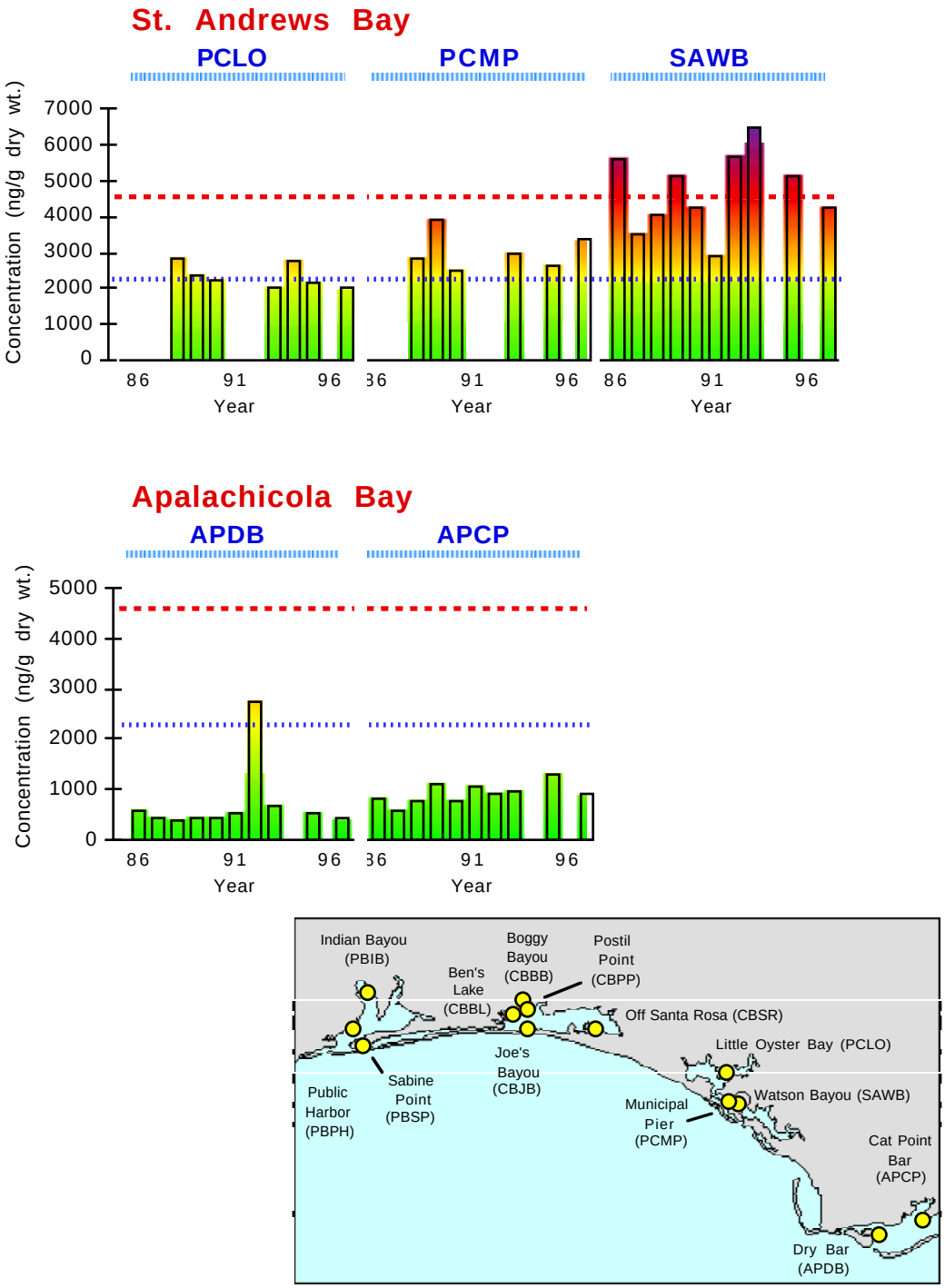
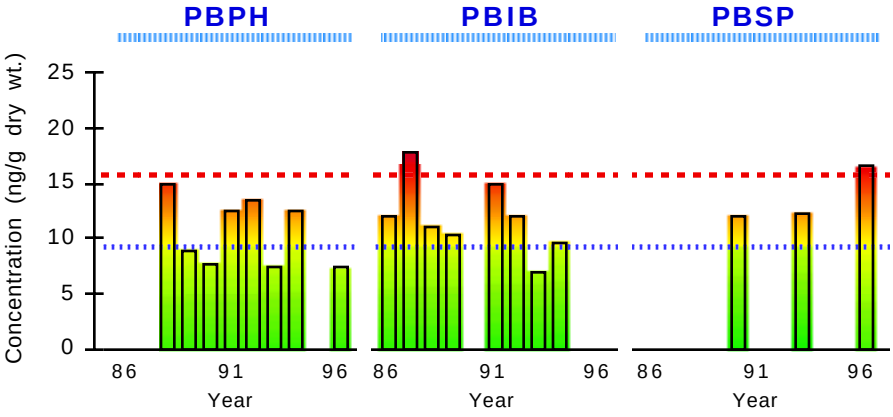


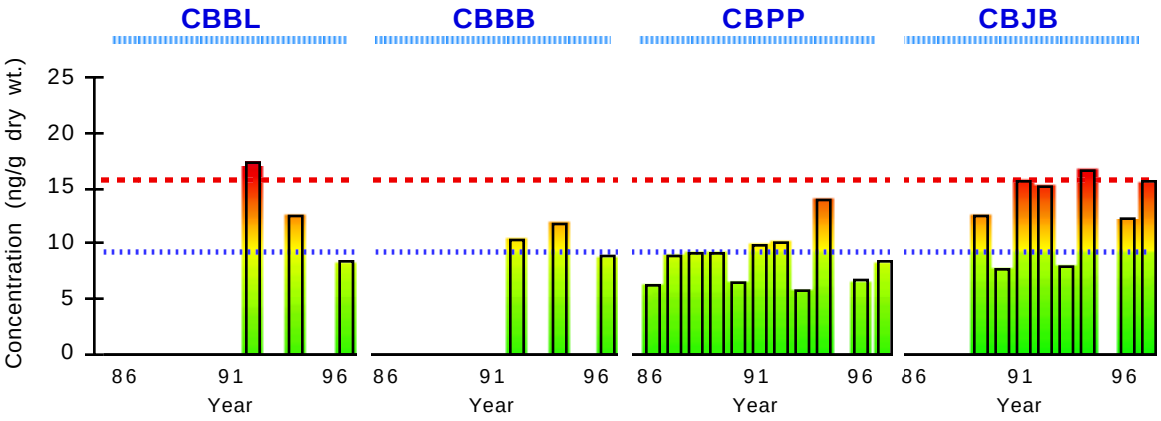
Figure II.3. Zinc trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

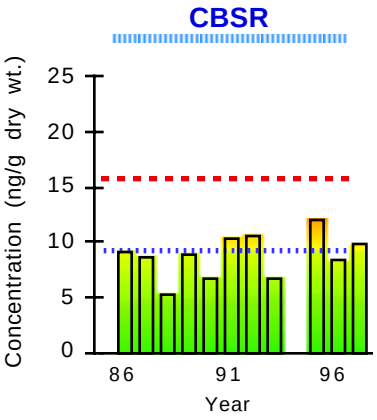
Arsenic in oysters

Pensacola Bay



Choctawhatchee Bay





Arsenic in oysters

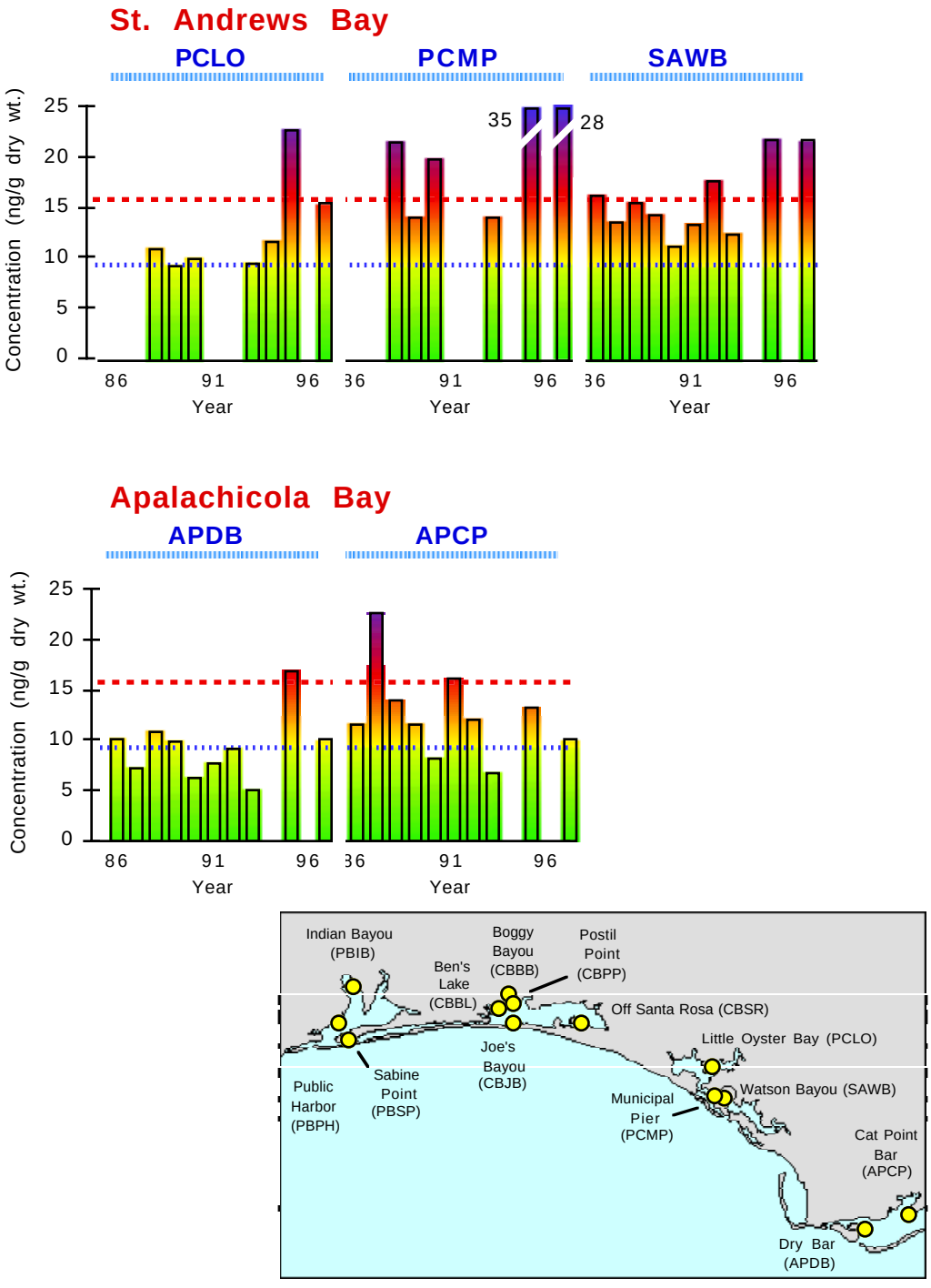
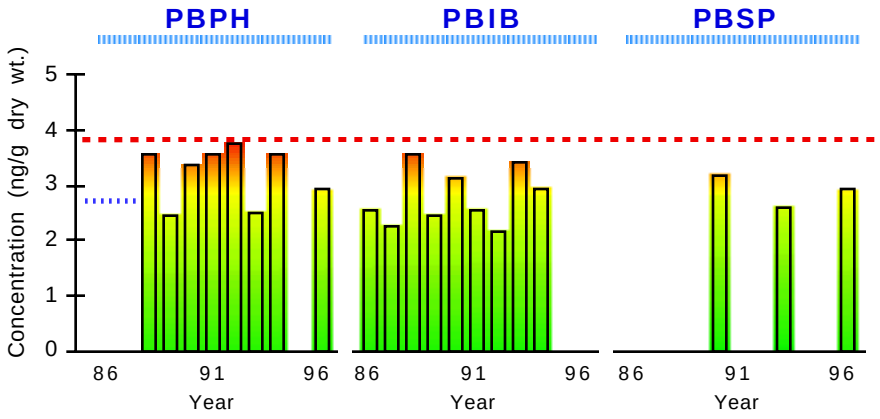


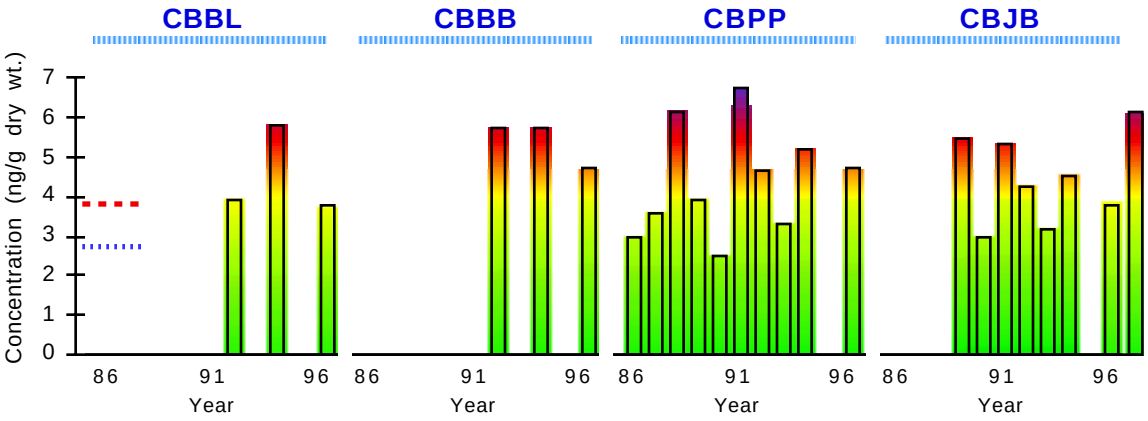
Figure II.4. Arsenic trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

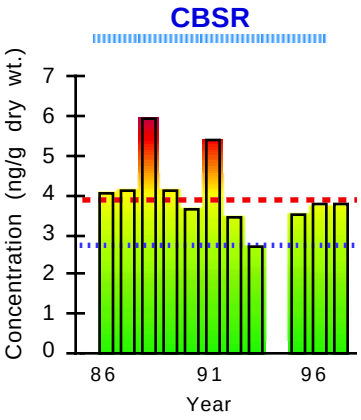
Selenium in oysters

Pensacola Bay



Choctawhatchee Bay





Selenium in oysters

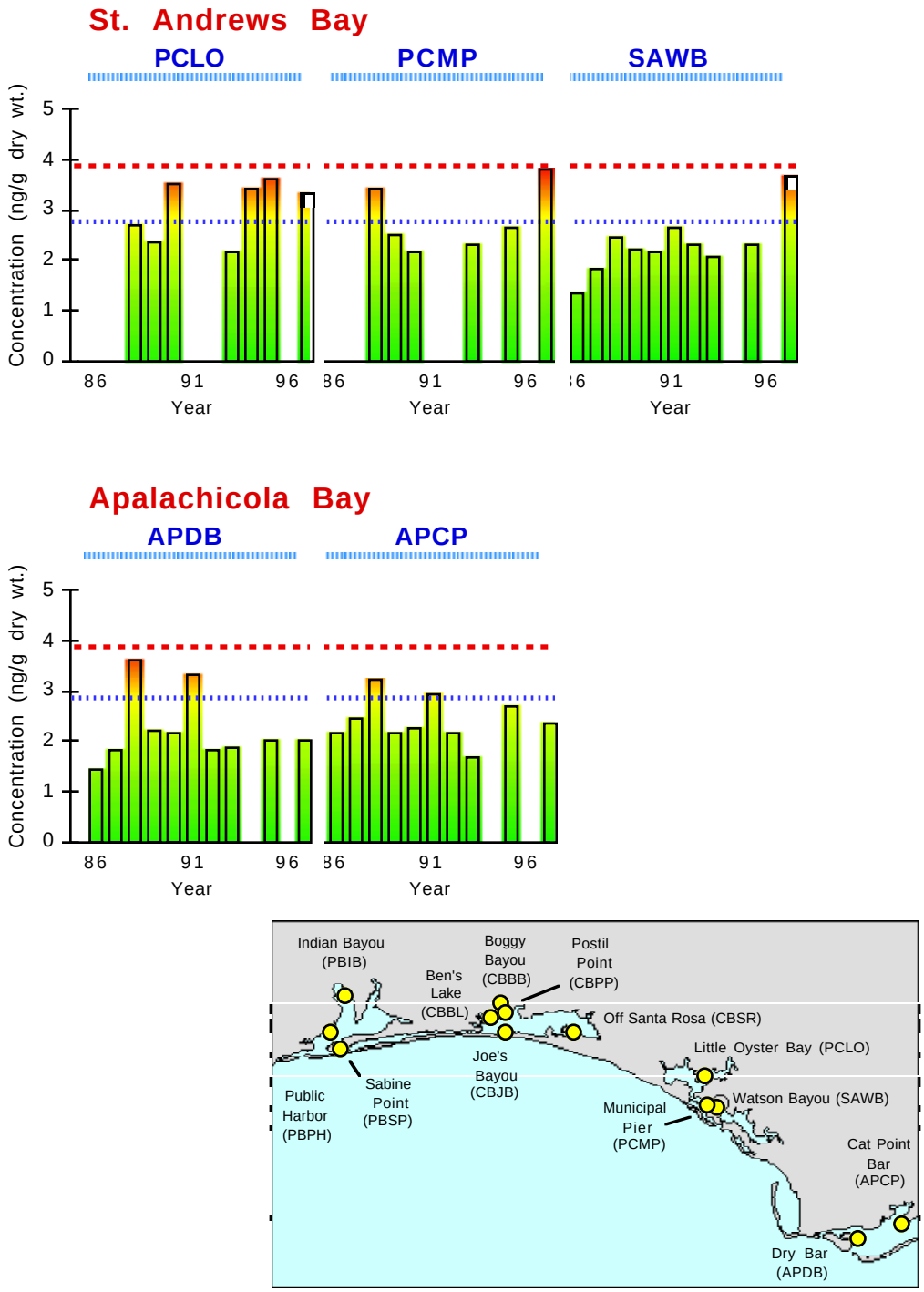
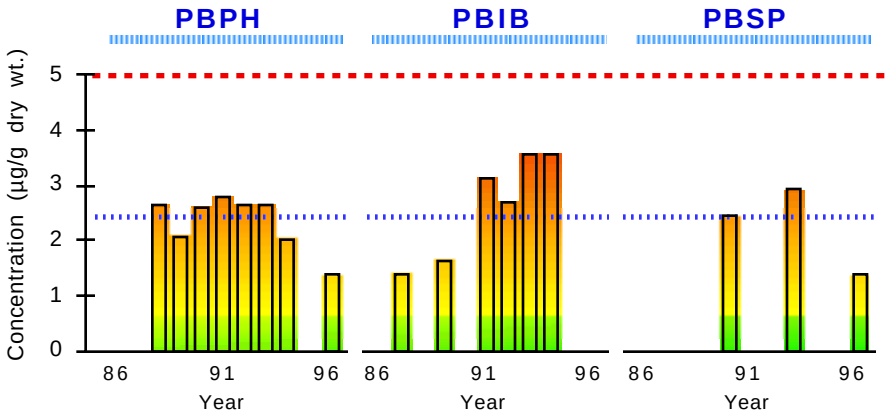


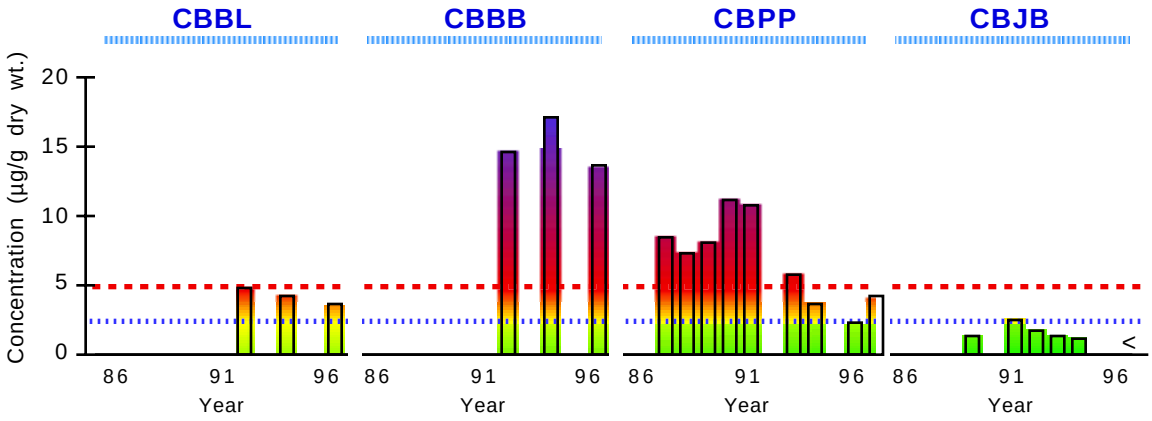
Figure II.5. Selenium trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

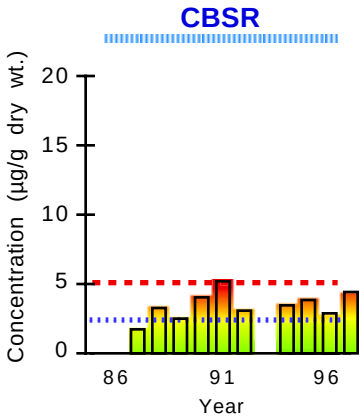
Silver in oysters

Pensacola Bay



Choctawhatchee Bay





Silver in oysters

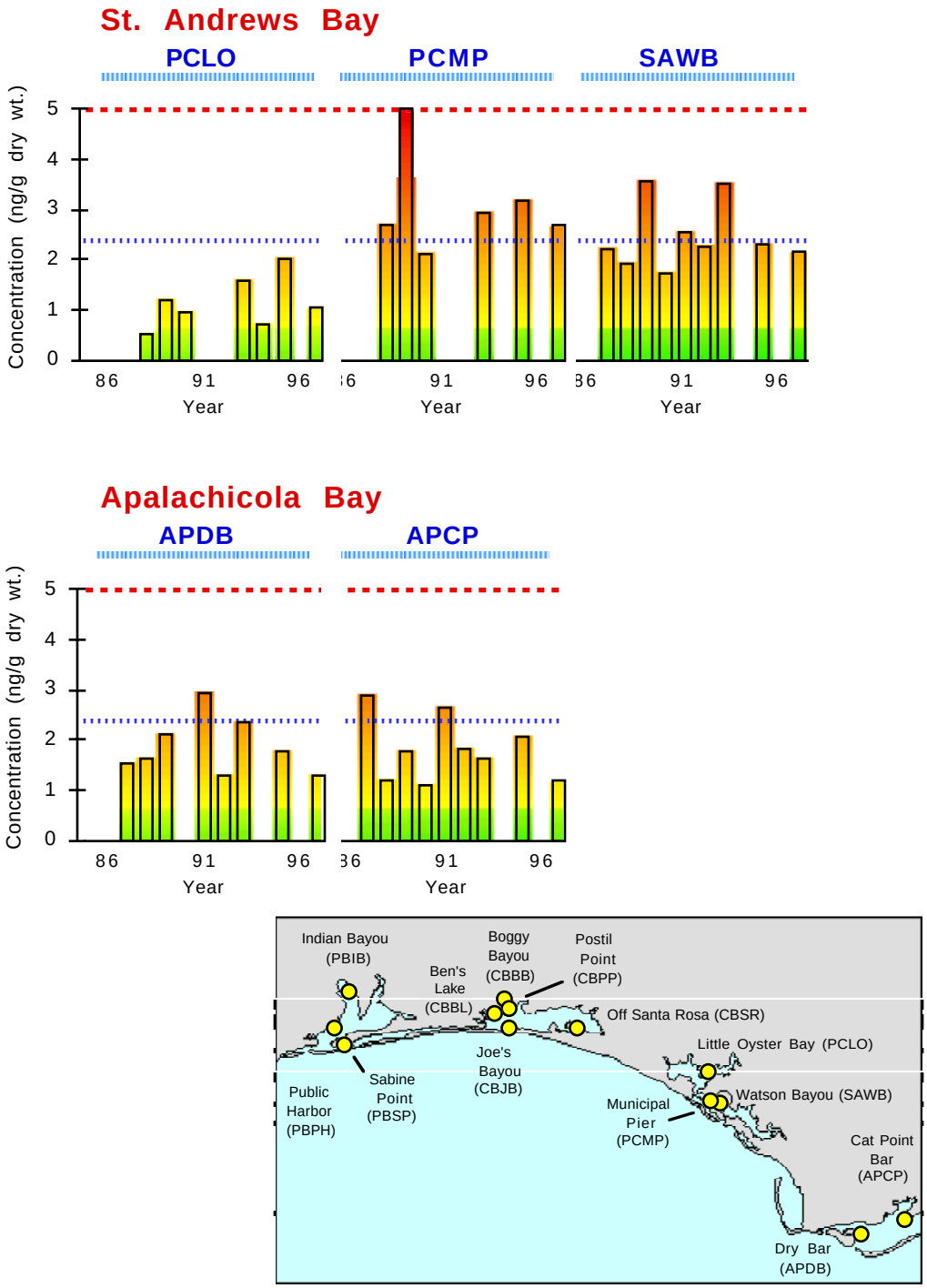
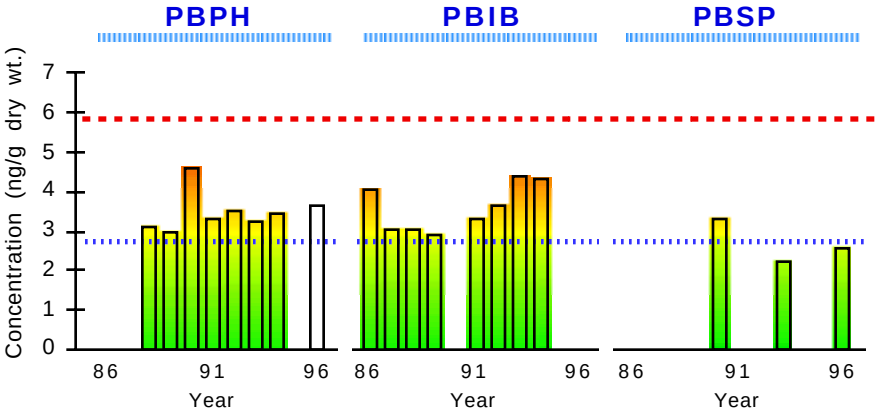


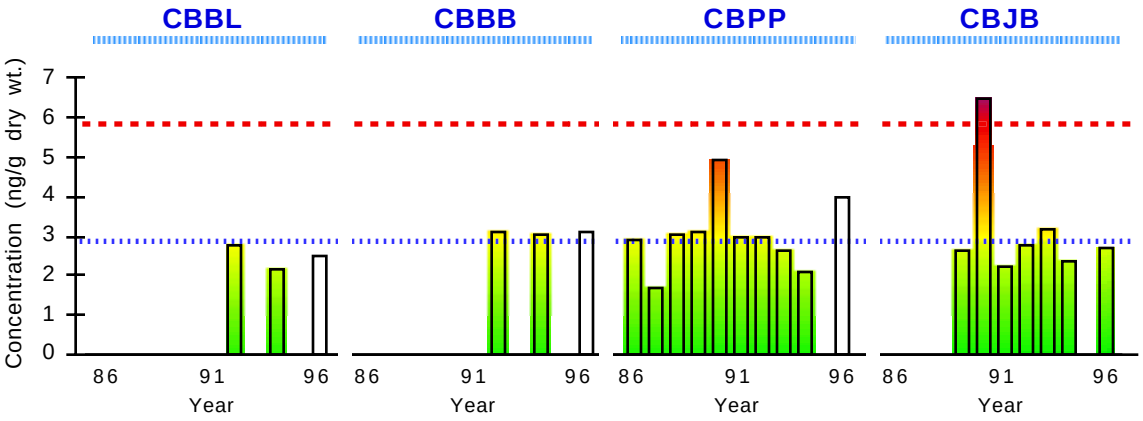
Figure II.6. Silver trends in oysters. A "<" used to indicate values below the limit of detection. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

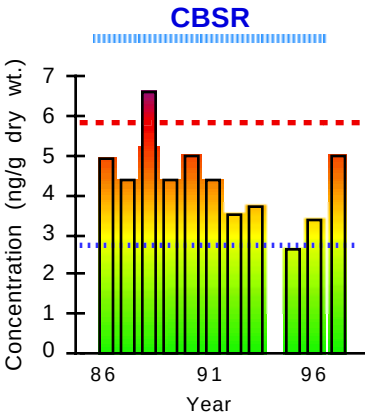
Cadmium in oysters

Pensacola Bay



Choctawhatchee Bay





Cadmium in oysters

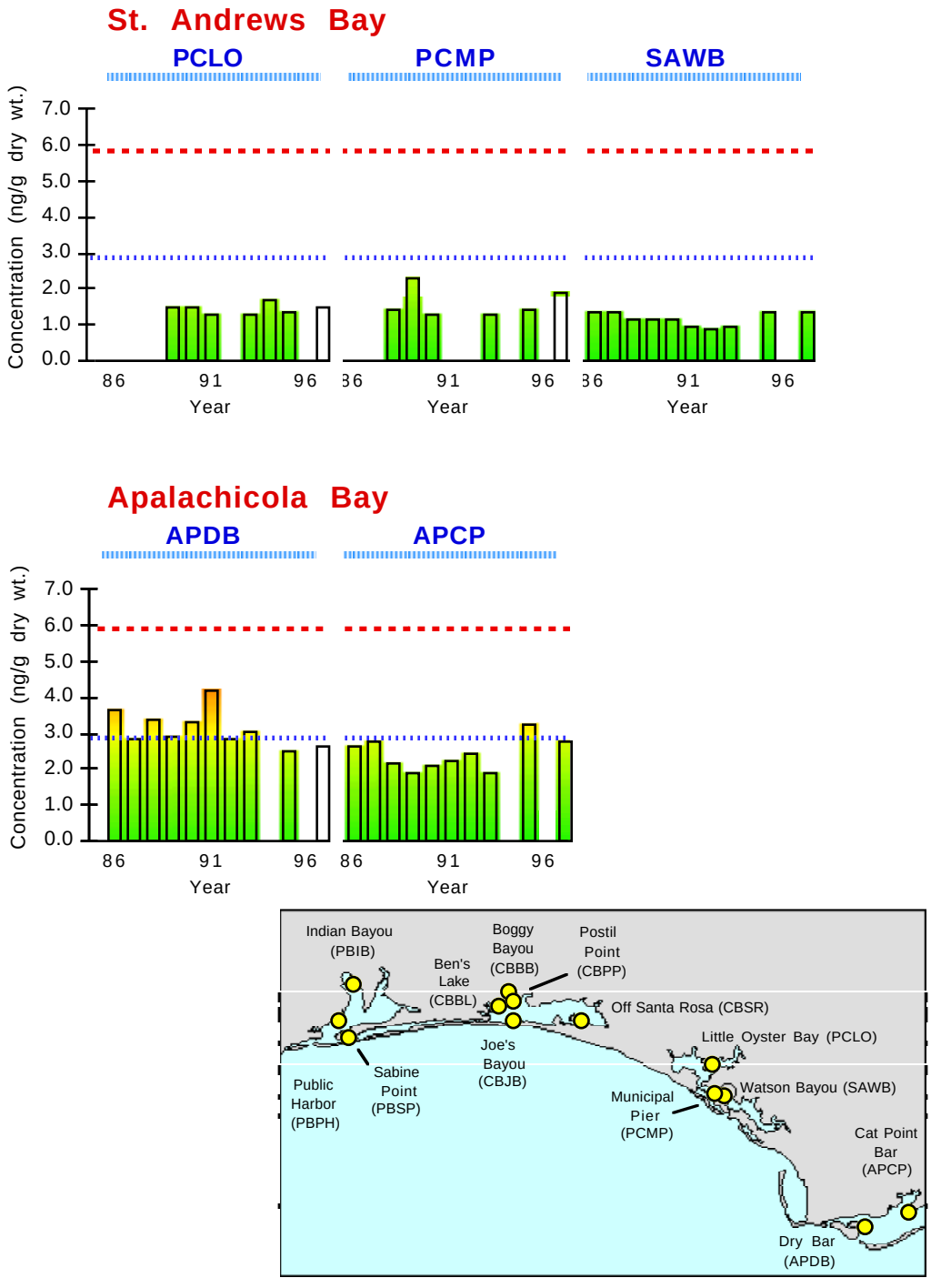
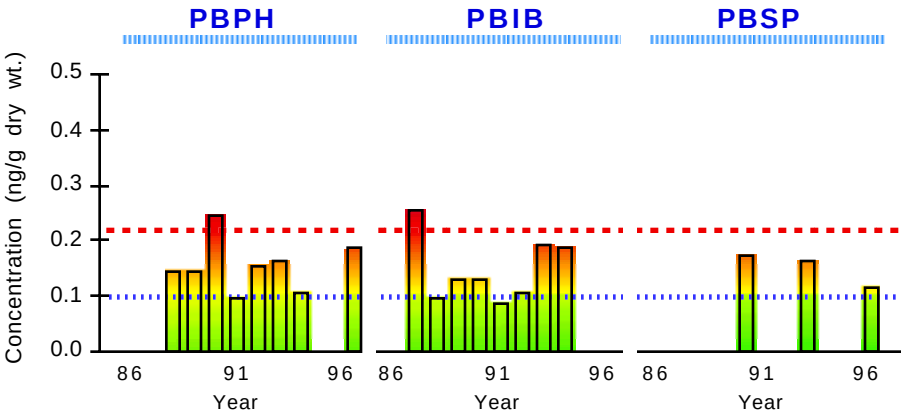


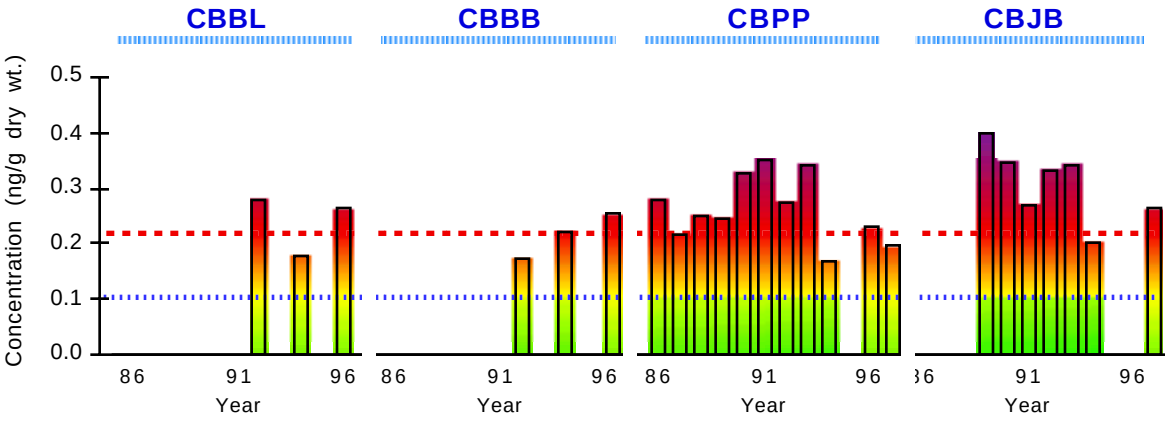
Figure II.7. Cadmium trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

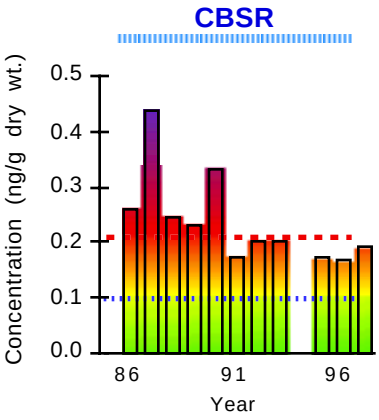
Mercury in oysters

Pensacola Bay



Choctawhatchee Bay





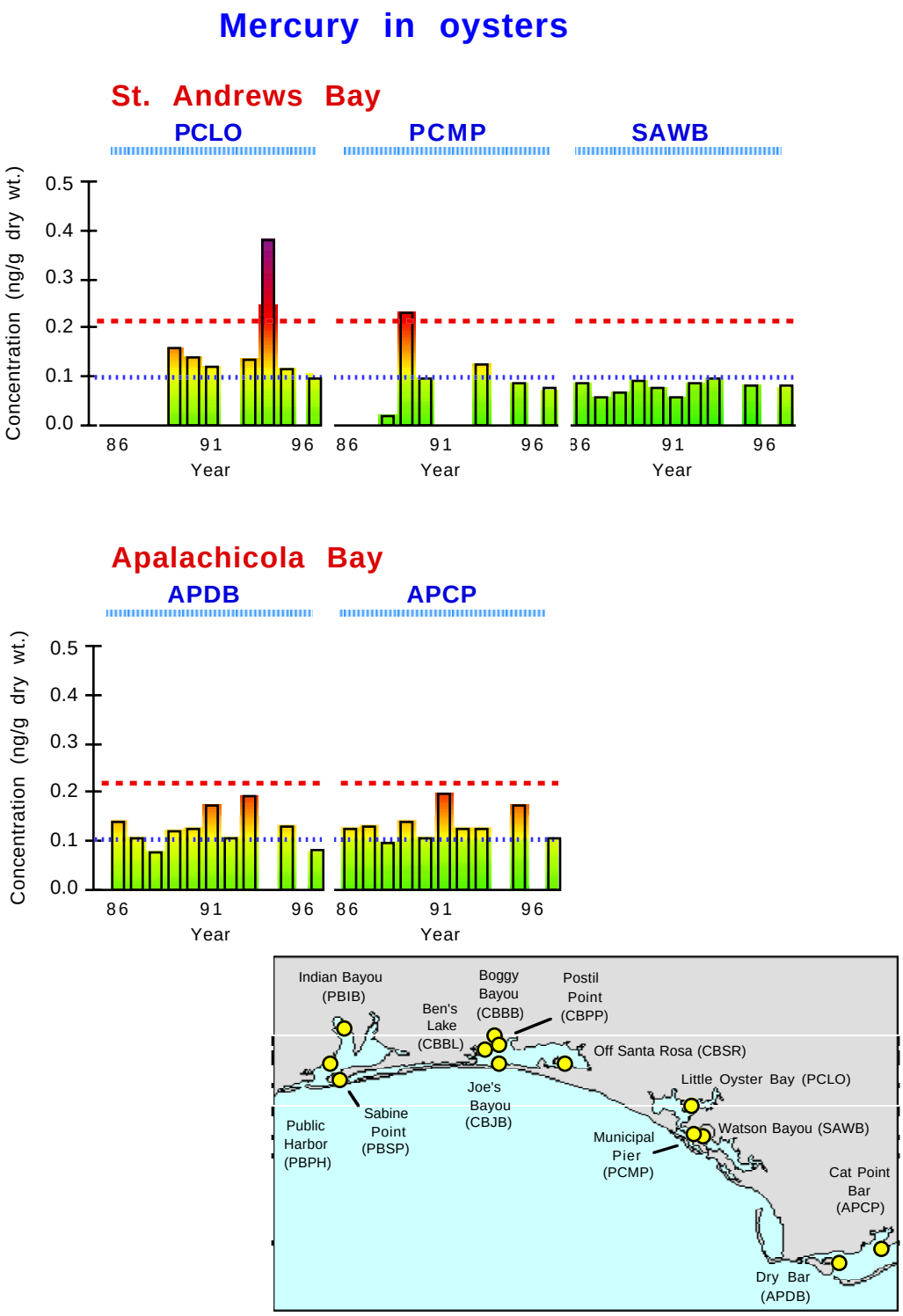
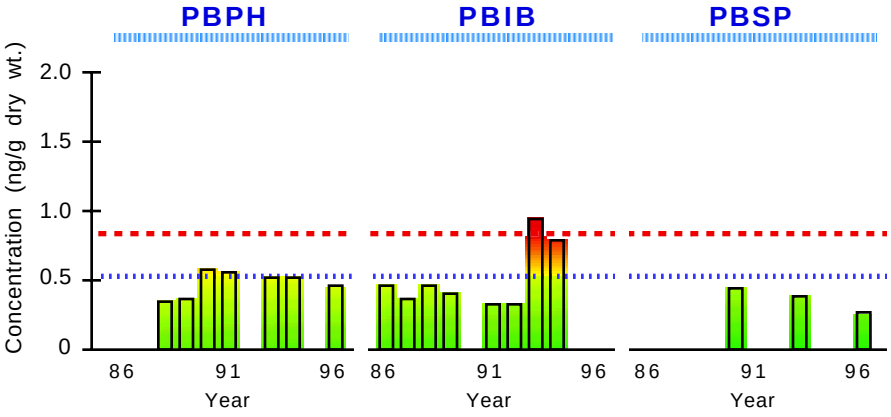


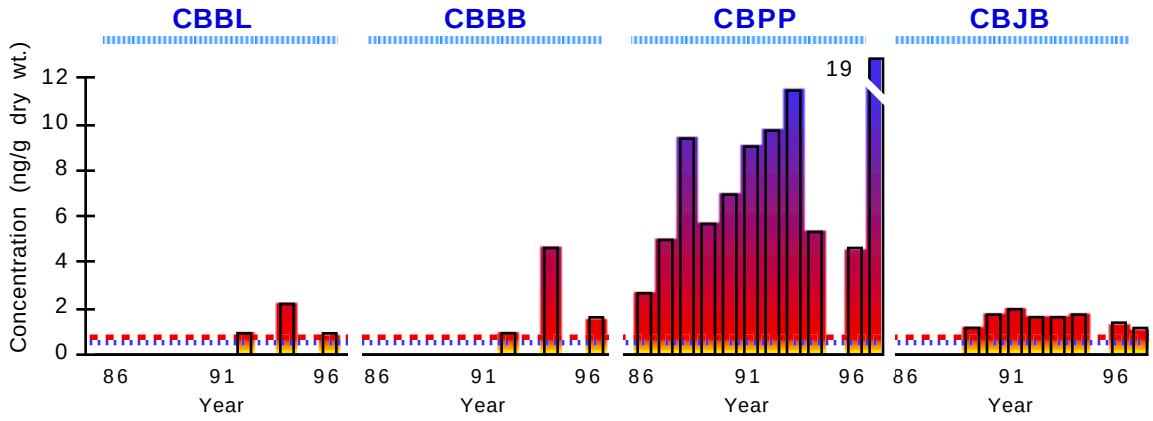
Figure II.8. Mercury trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

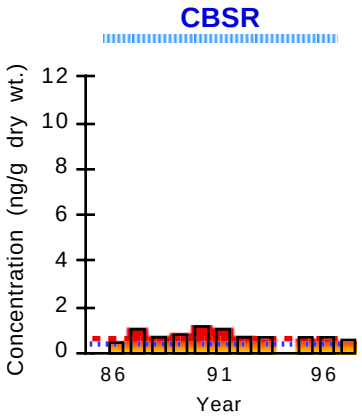
Lead in oysters

Pensacola Bay



Choctawhatchee Bay





Lead in oysters

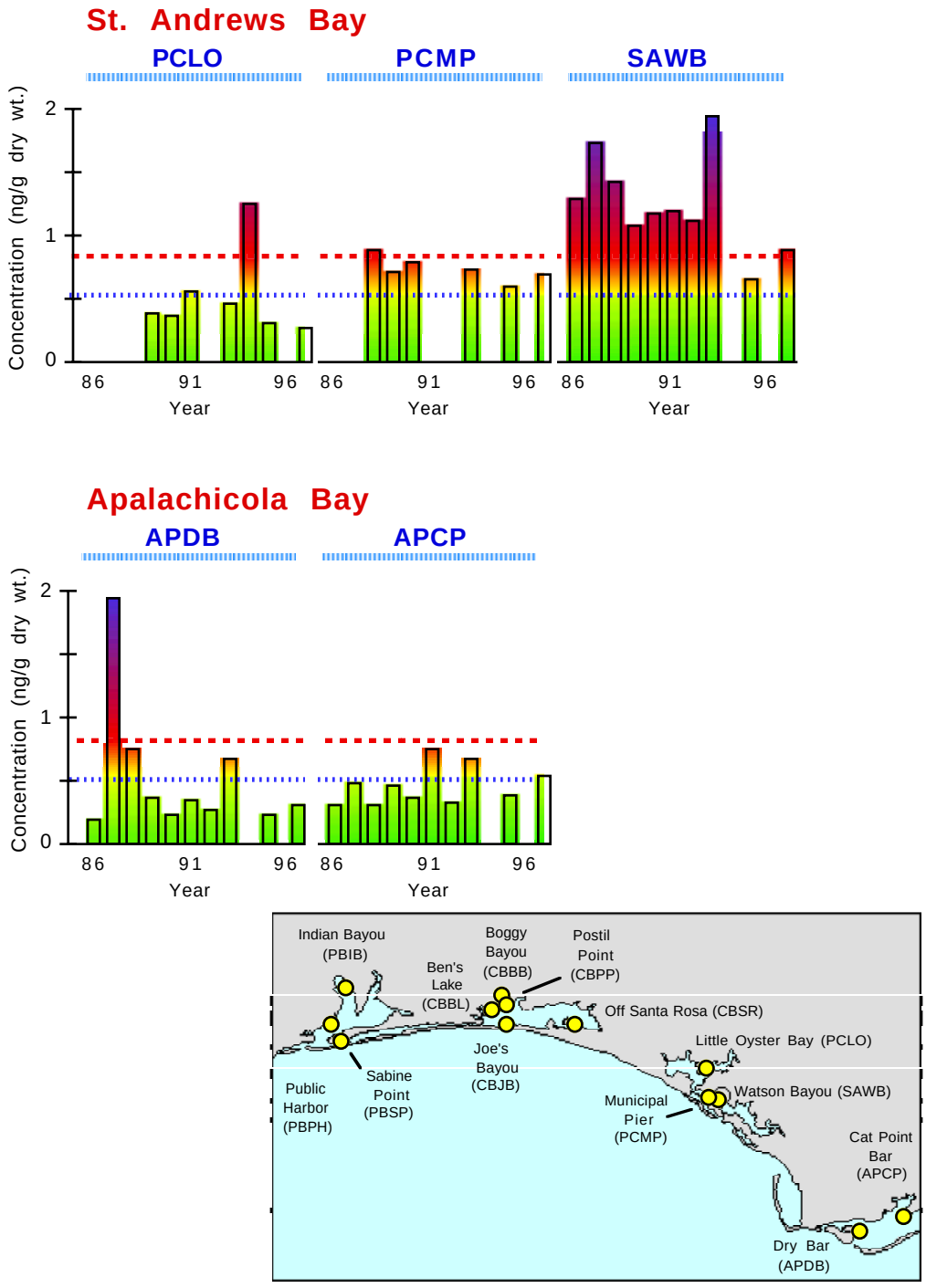
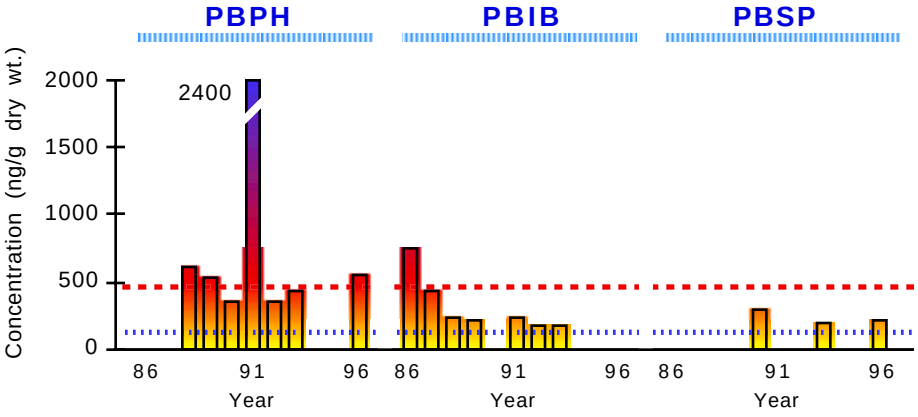


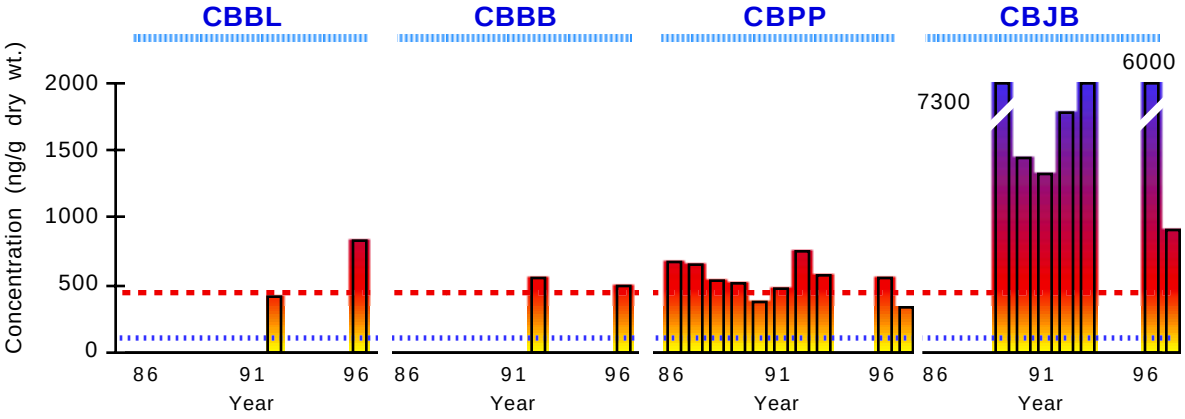
Figure II.9. Lead trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

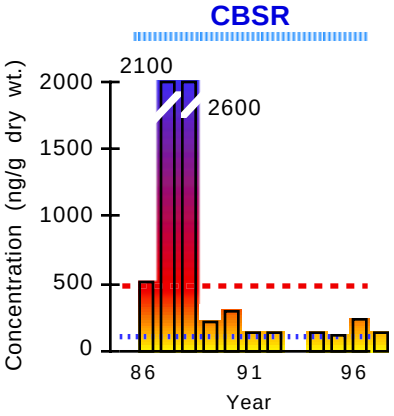
ÂPAHs in oysters

Pensacola Bay



Choctawhatchee Bay





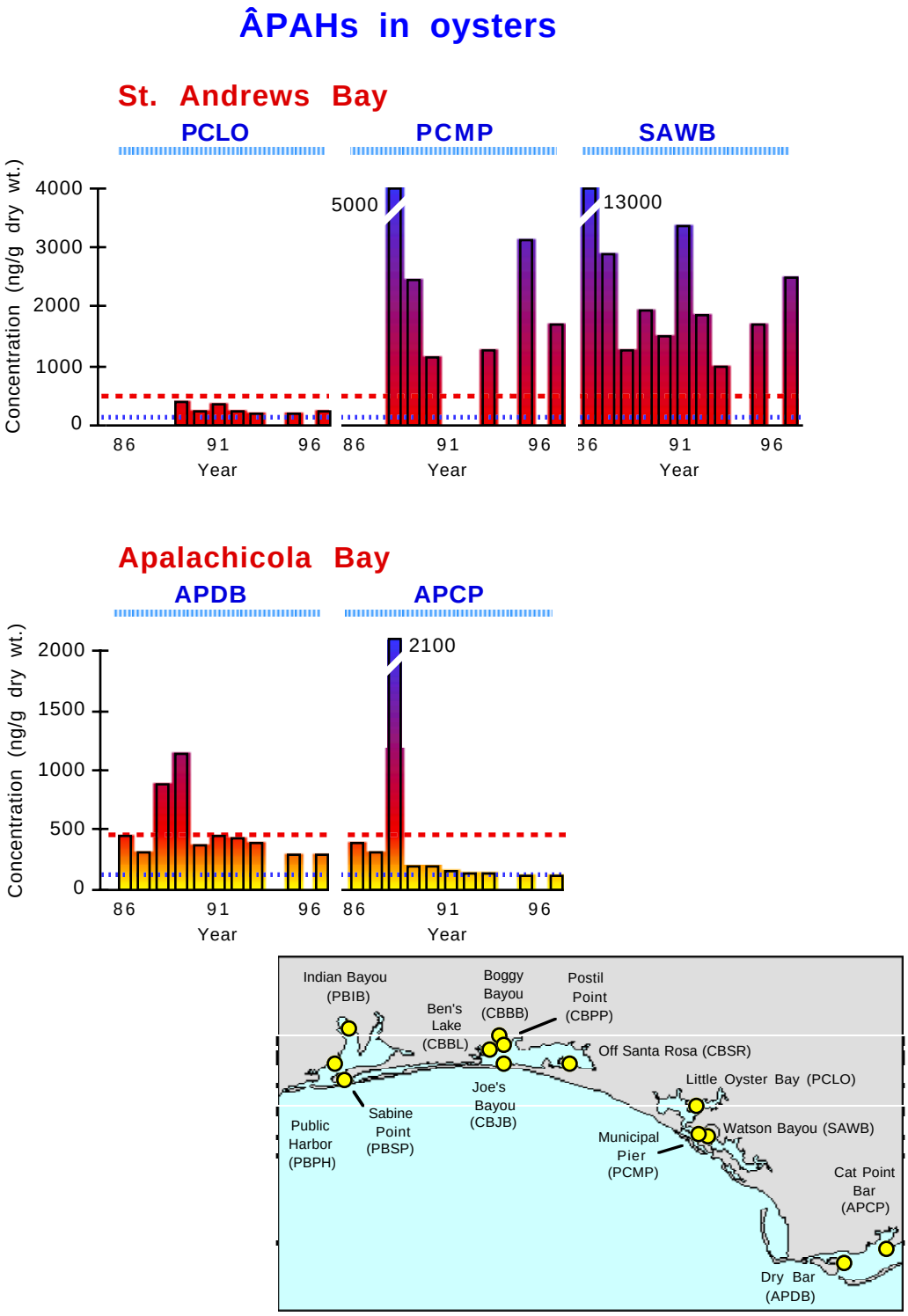
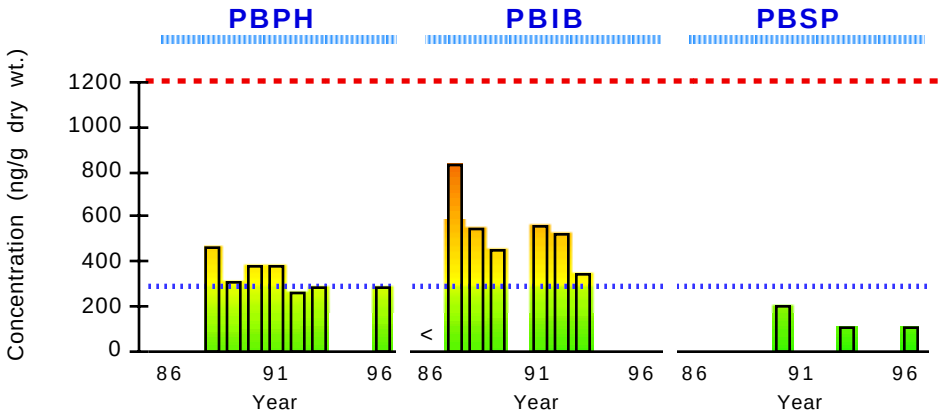


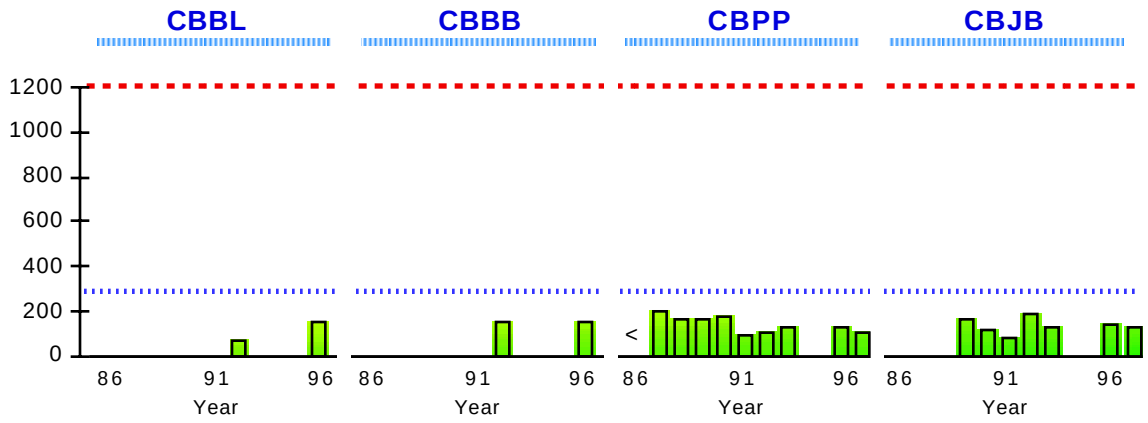
Figure II.10. Total PAHs trends in oysters. A "<" used to indicate values below the limit of detection. Dotted blue line is NS&T median. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

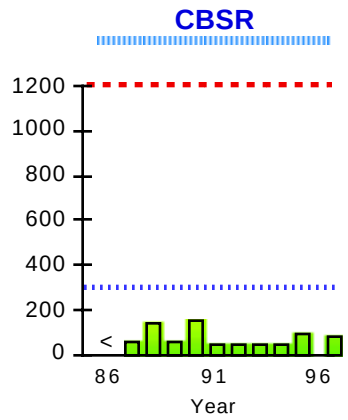
ÂPCBs in oysters

Pensacola Bay



Choctawhatchee Bay





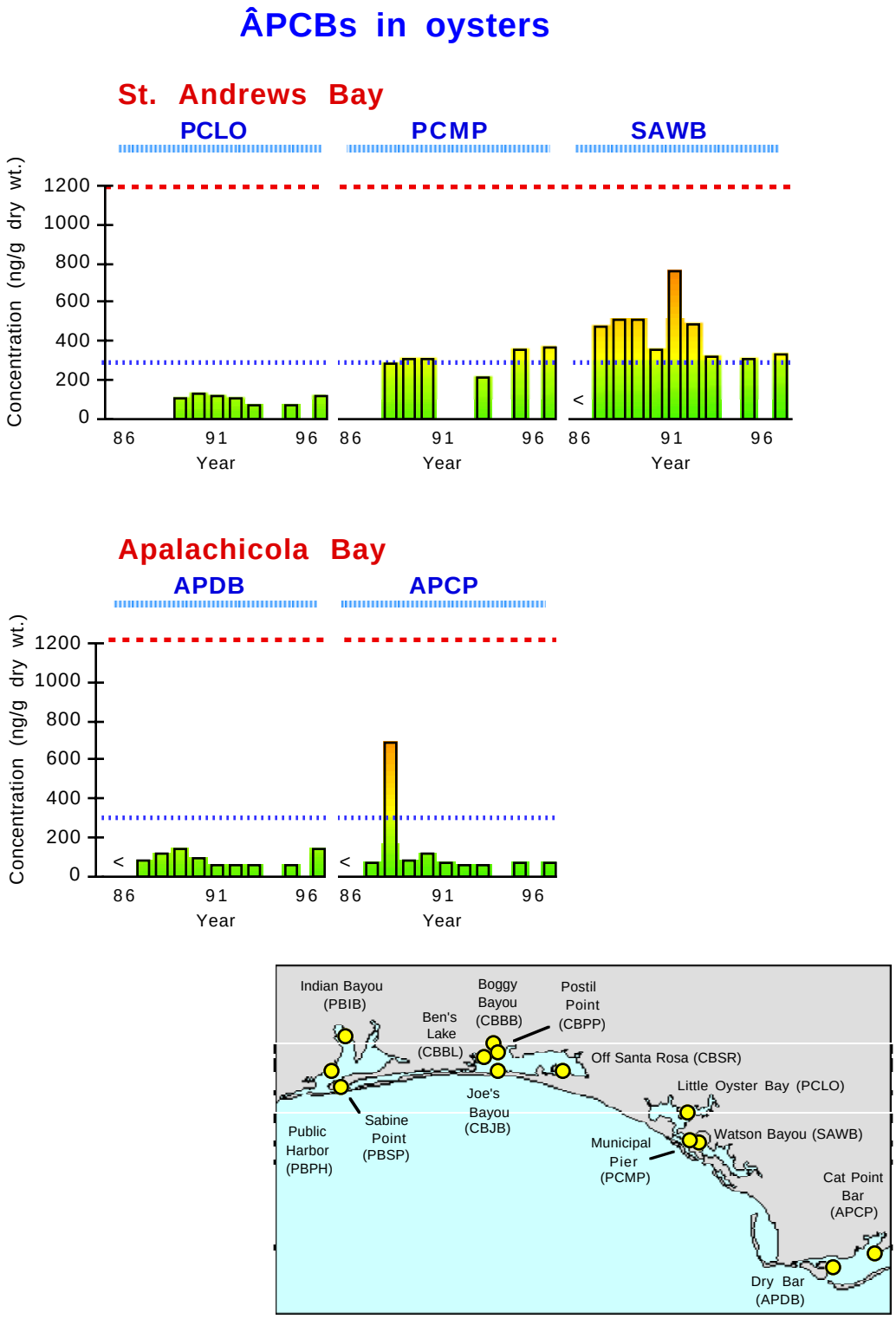
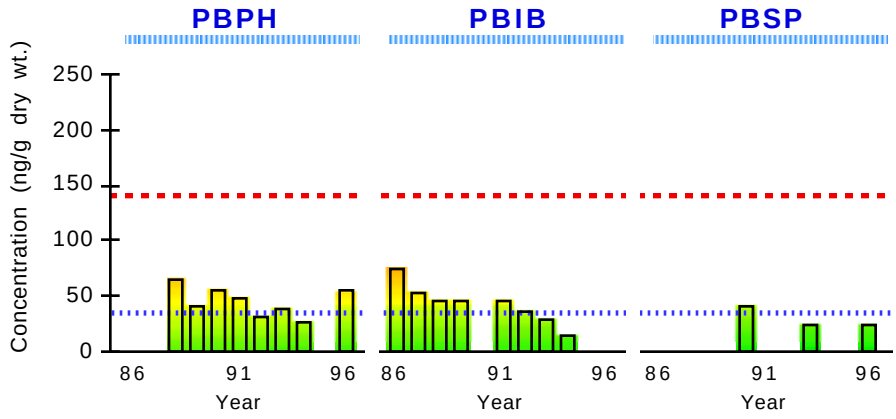


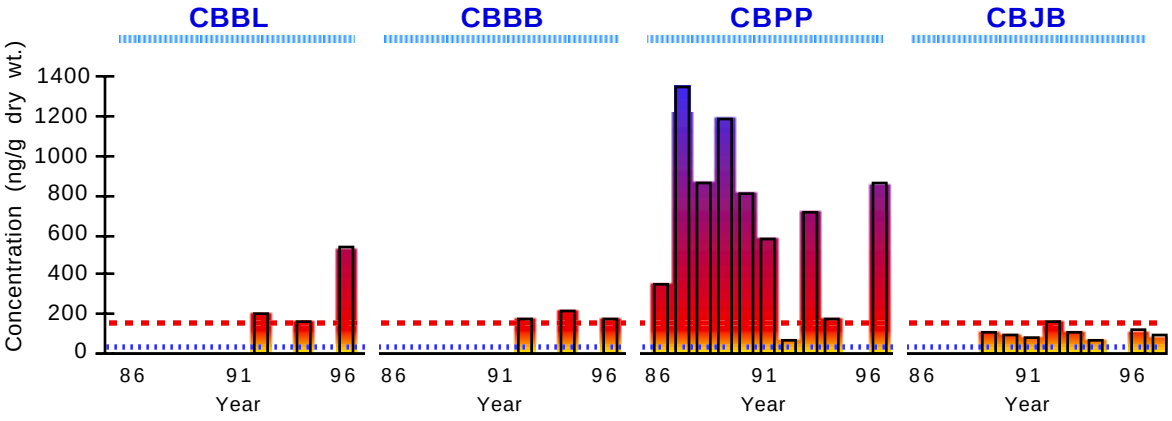
Figure II.11. Total PCBs trends in oysters. Dotted blue line is NS&T median. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

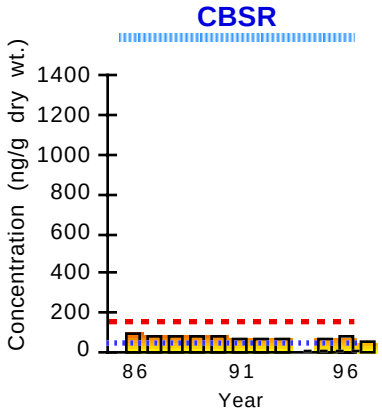
ÂDDT and metabolites in oysters

Pensacola Bay



Choctawhatchee Bay





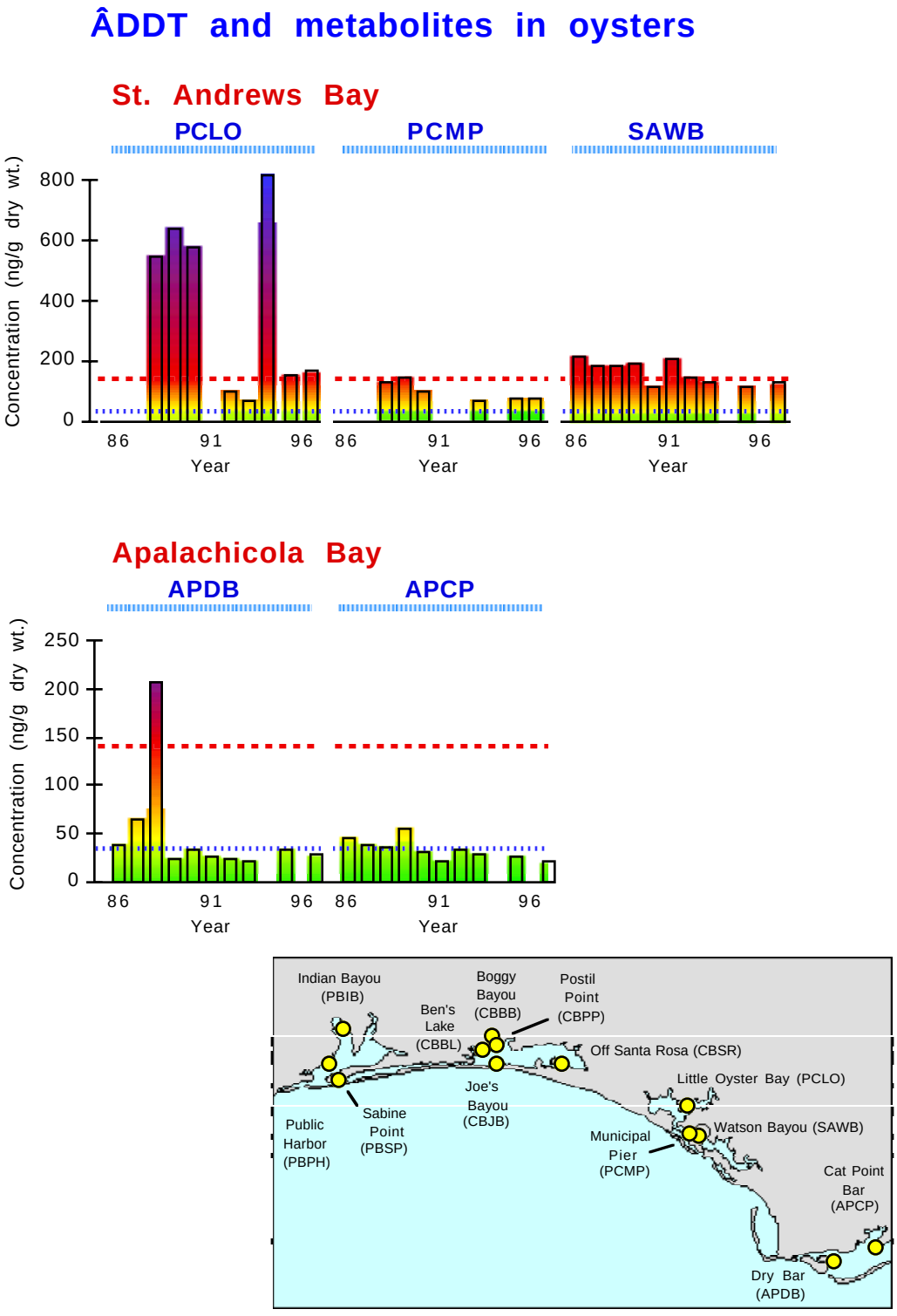
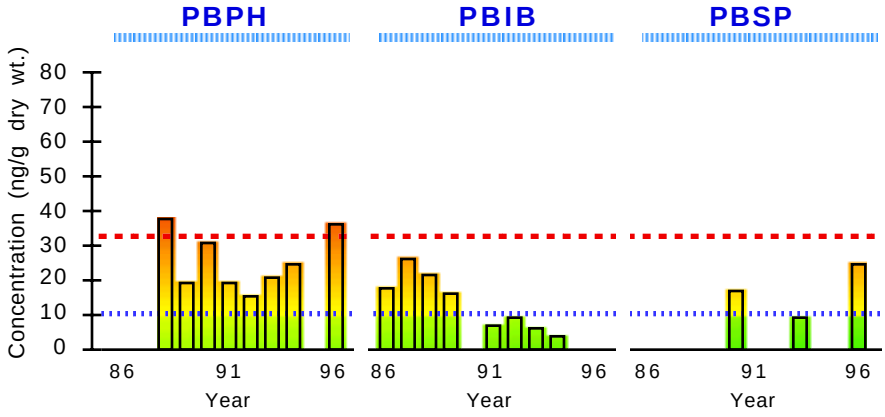


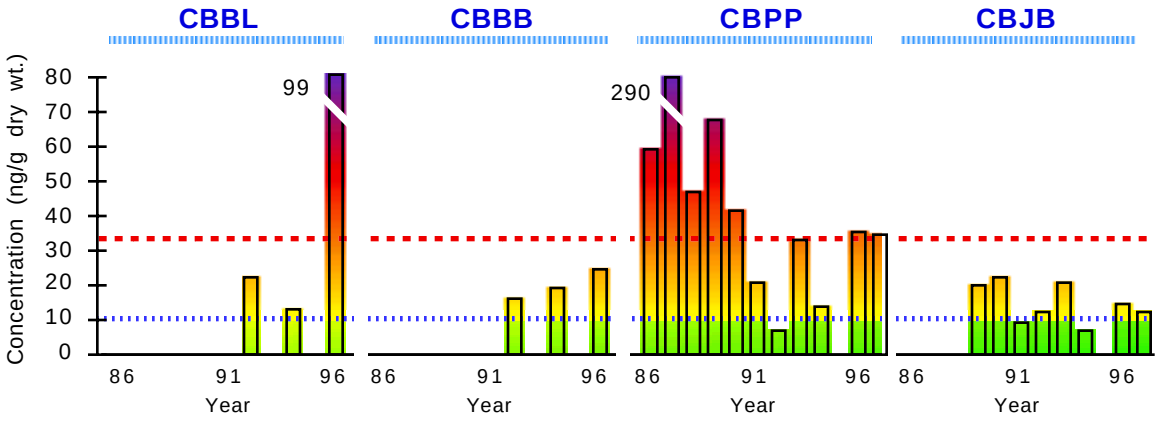
Figure II.12. Total DDTs and metabolites trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

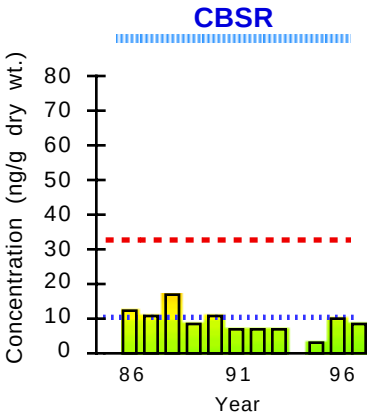
Total chlordane pesticides in oysters

Pensacola Bay



Choctawhatchee Bay





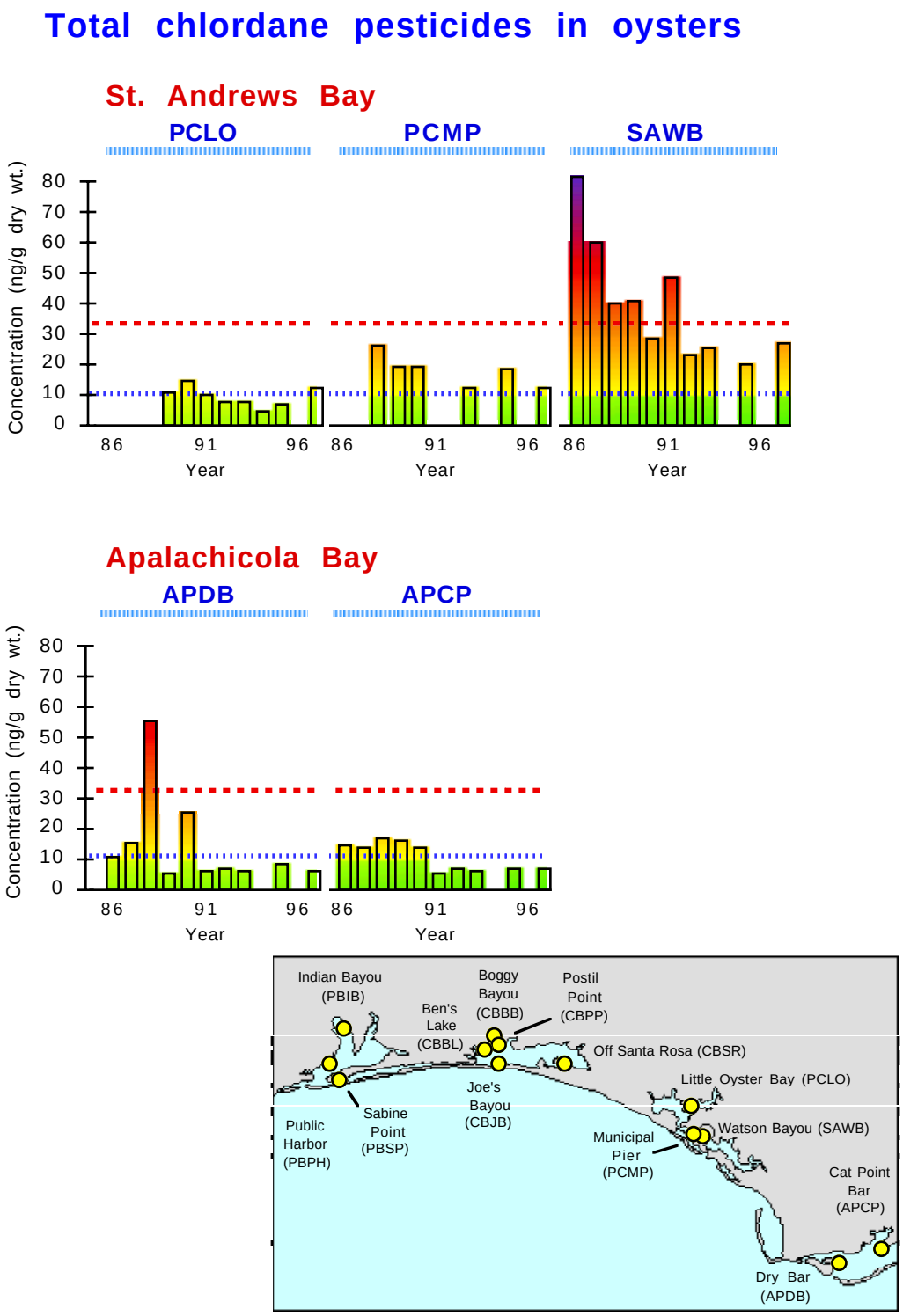
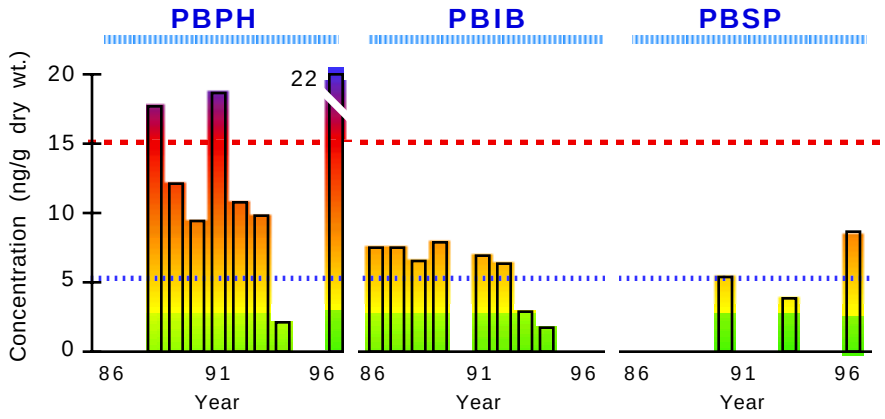


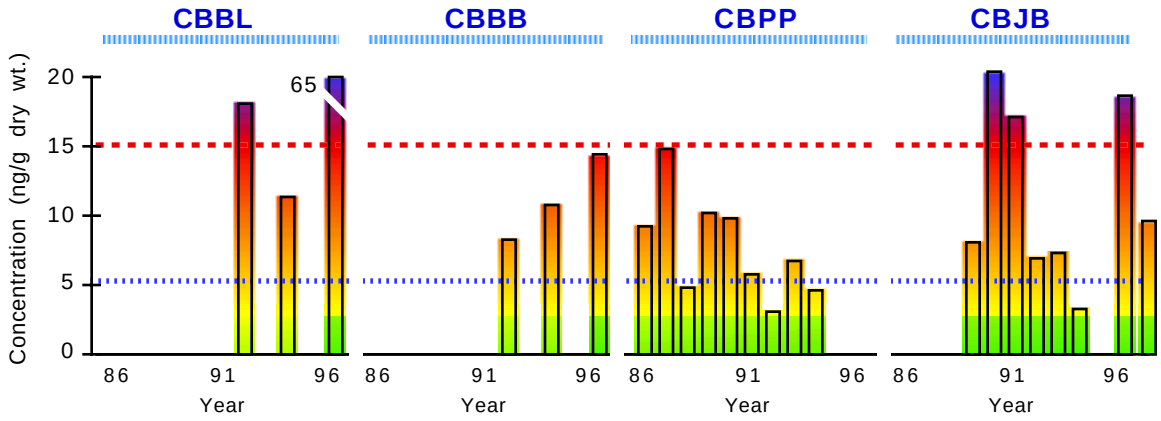
Figure II.13. Total chlordane pesticides trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

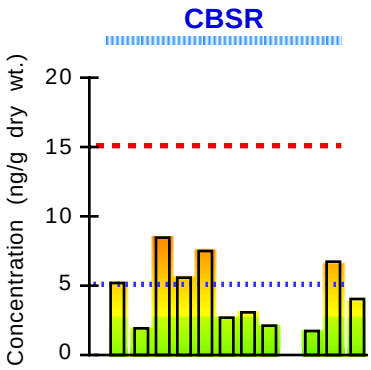
Dieldrin + aldrin in oysters

Pensacola Bay



Choctawhatchee Bay





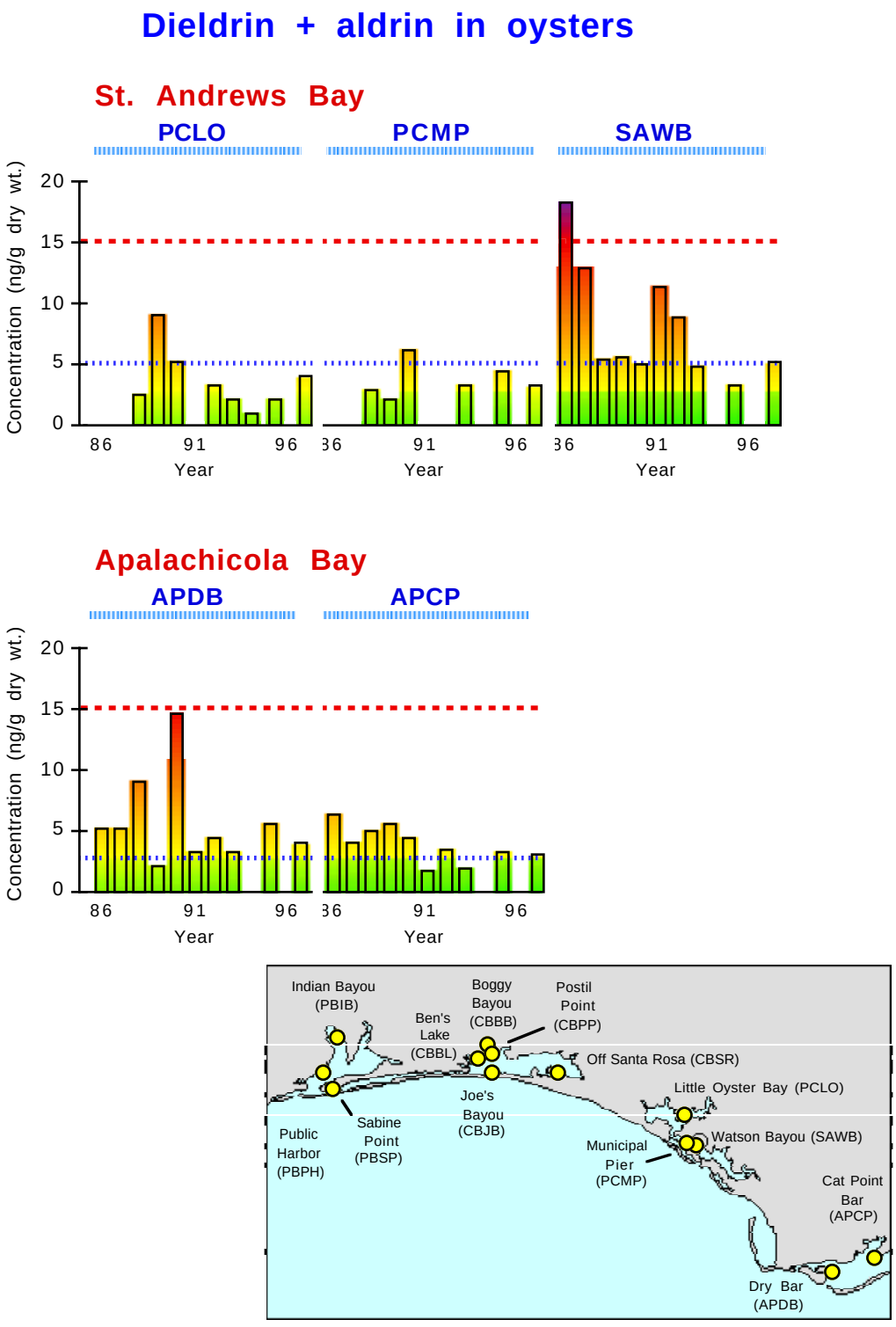
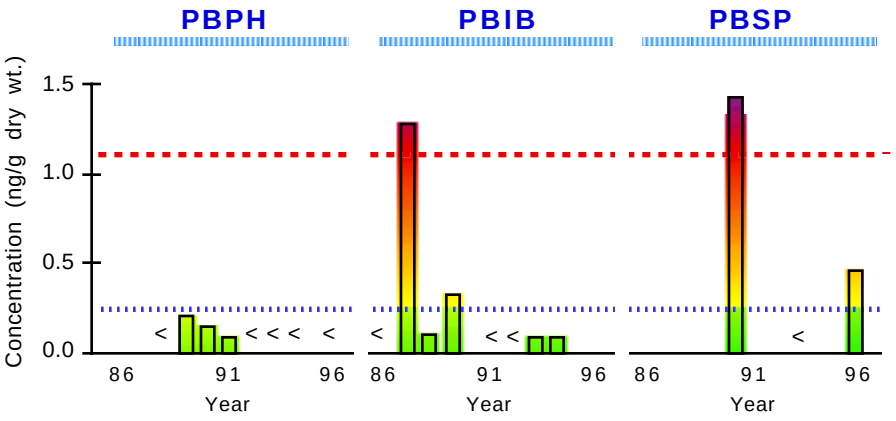


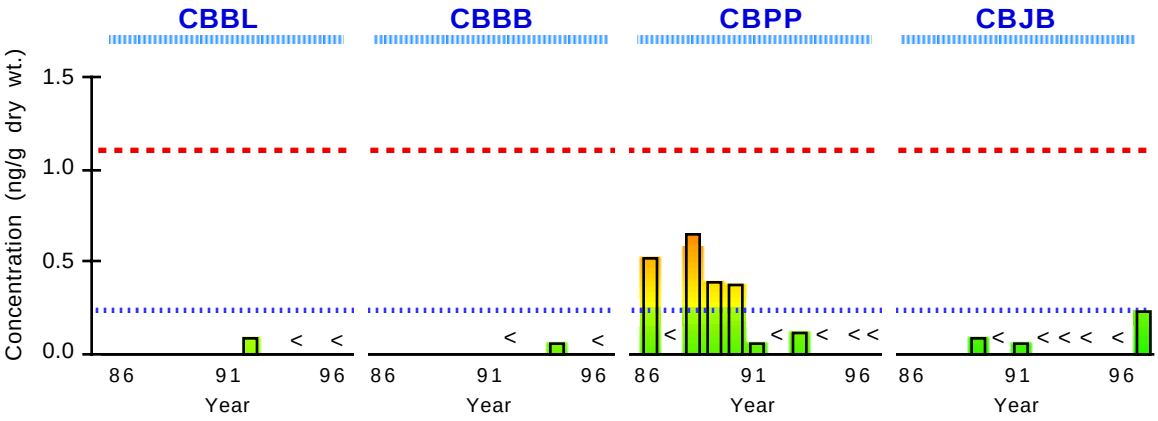
Figure II.14. Dieldrin and aldrin trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

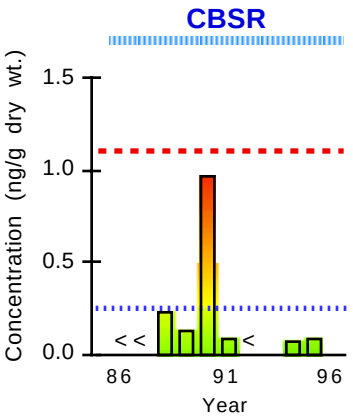
Hexachlorobenzene in oysters

Pensacola Bay



Choctawhatchee Bay





Hexachlorobenzene in oysters

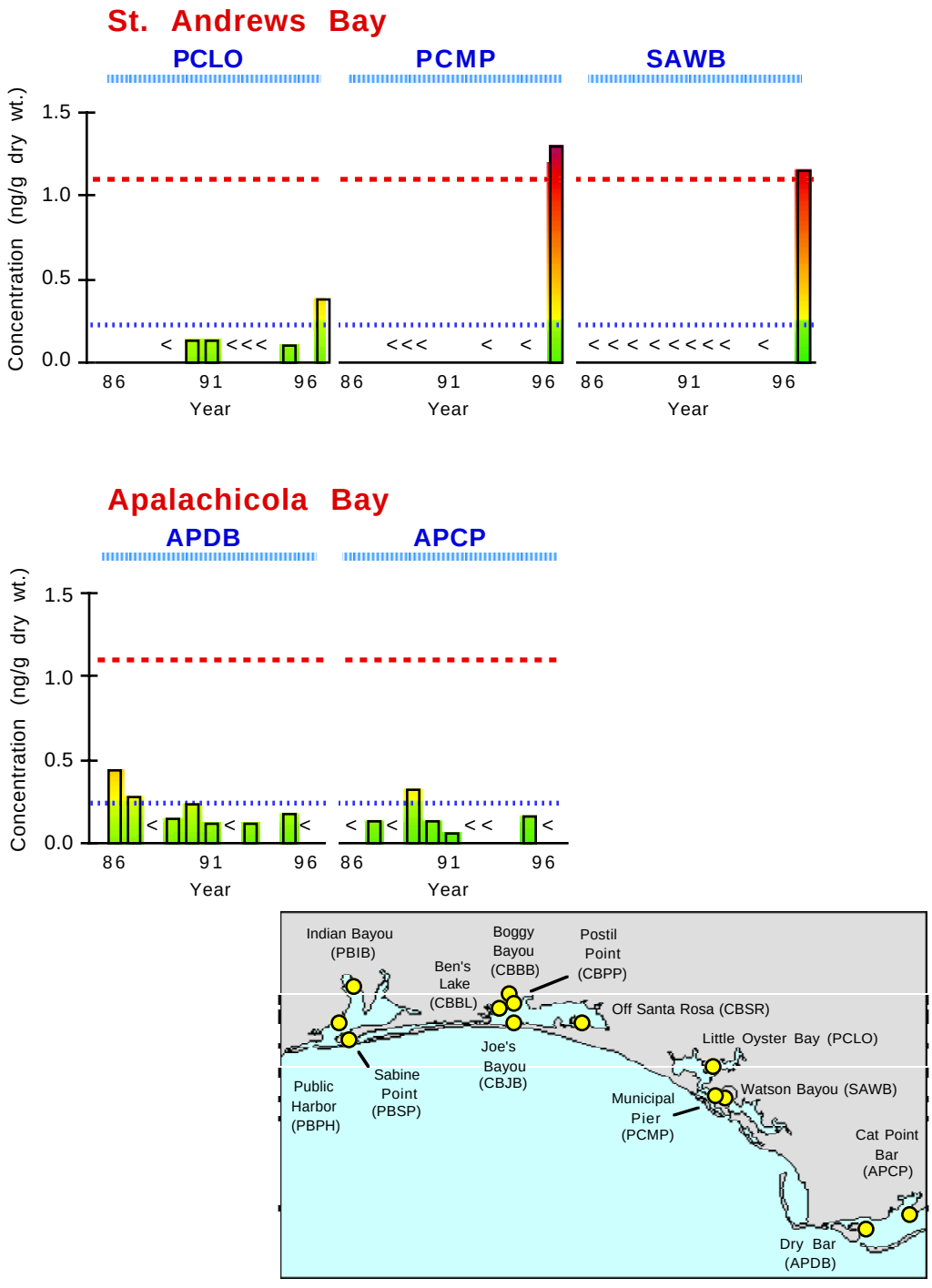
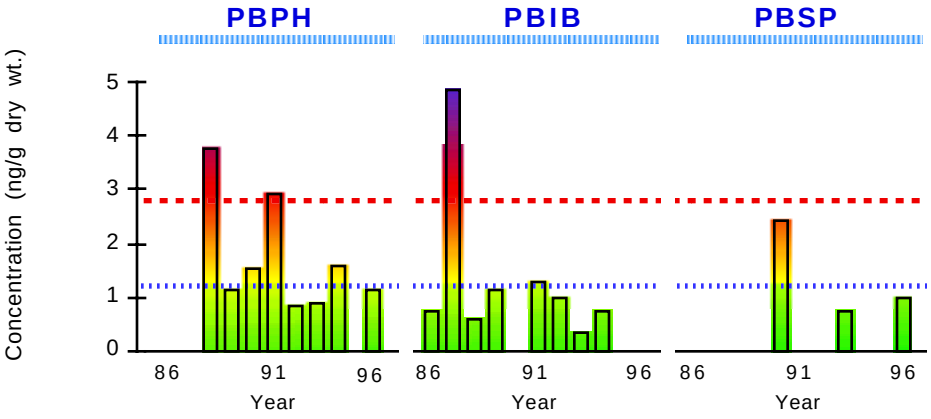


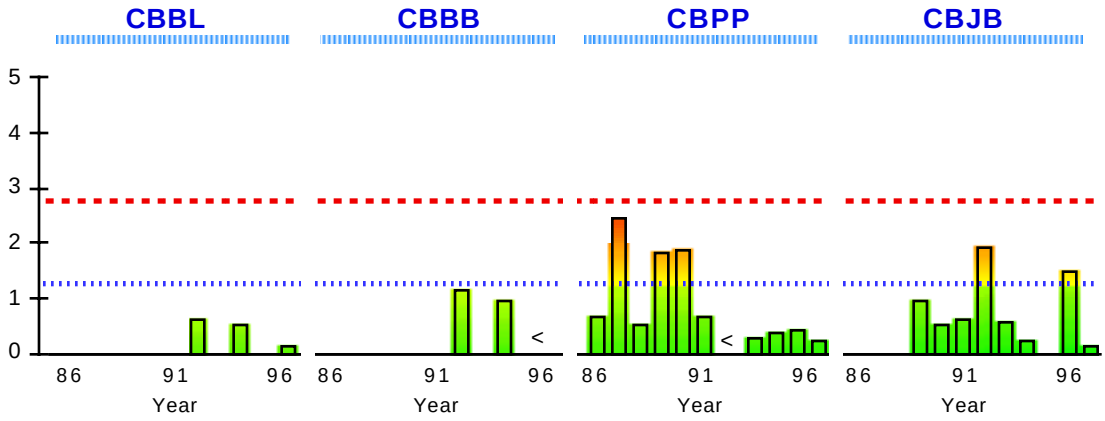
Figure II.15. Hexachlorobenzene trends in oysters. A "<" used to indicate values below the limit of detection. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

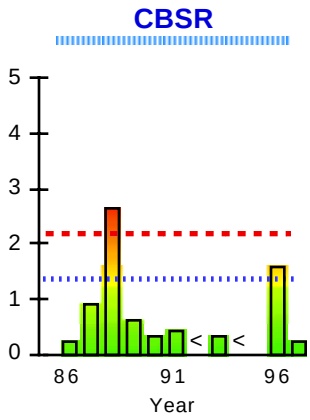
Lindane in oysters

Pensacola Bay



Choctawhatchee Bay





Lindane in oysters

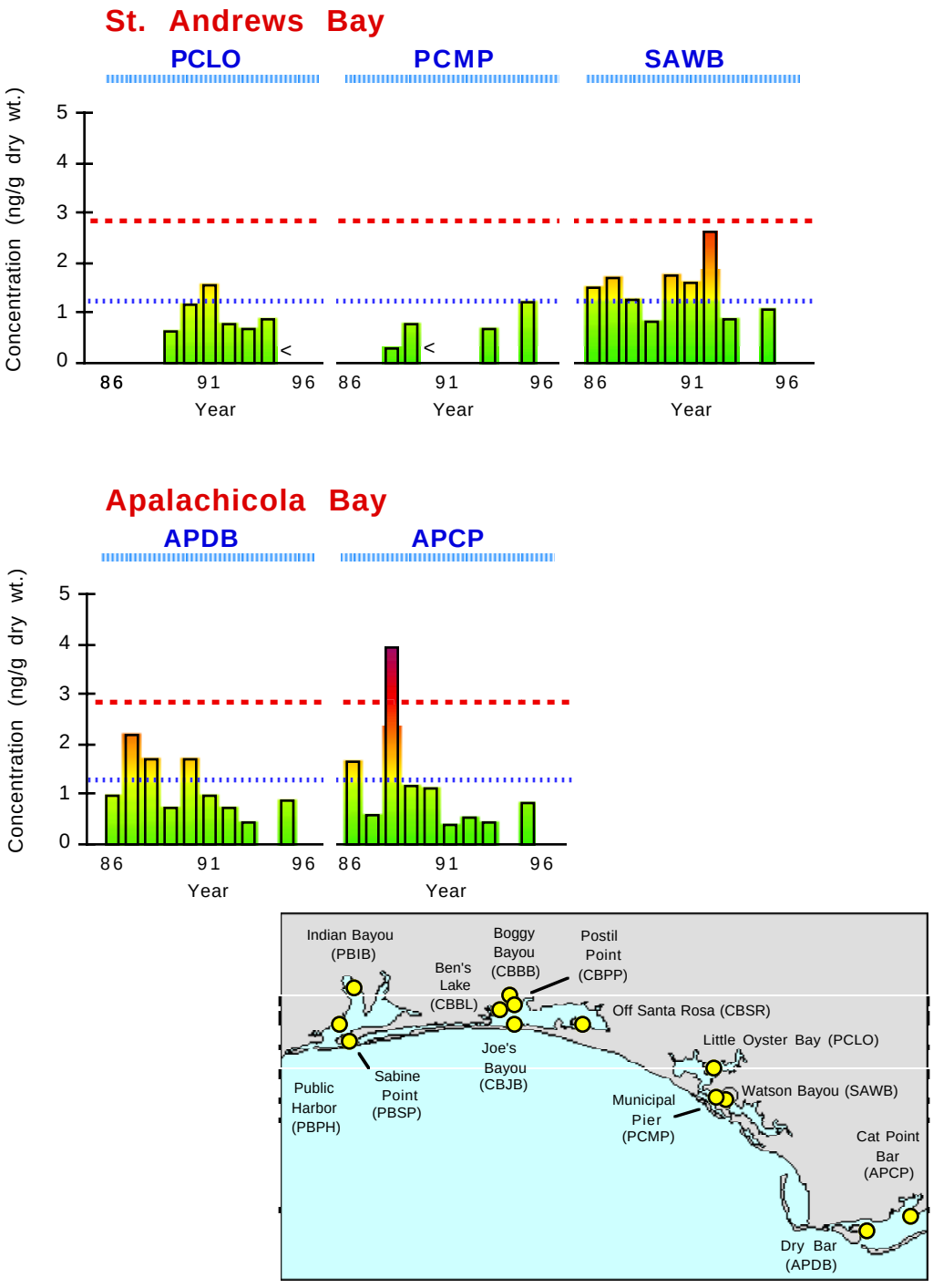
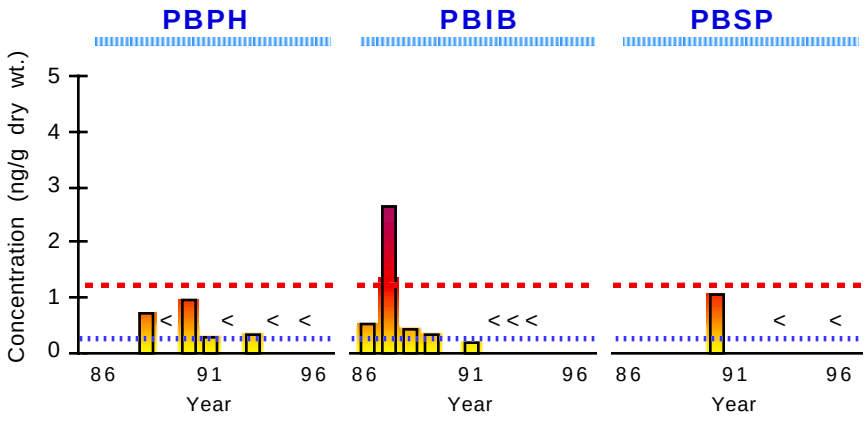


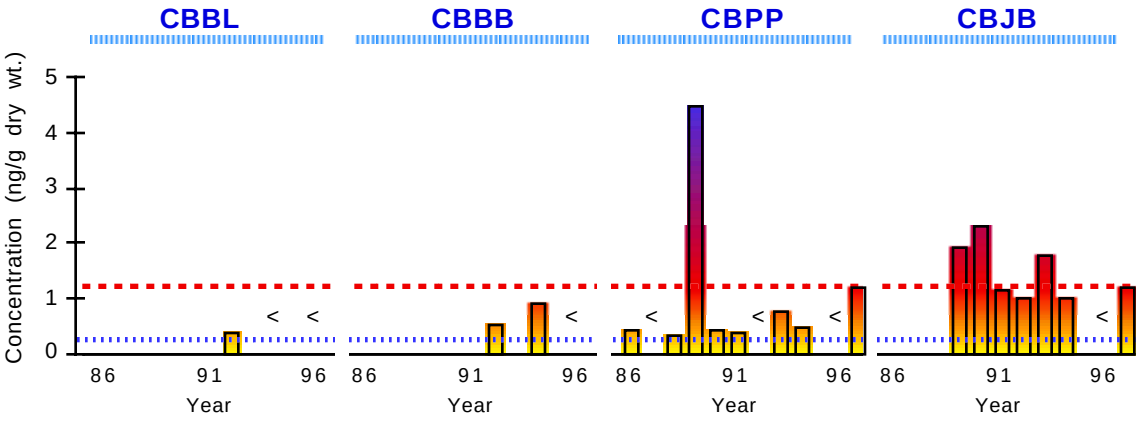
Figure II.16. Lindane trends in oysters. A "<" used to indicate values below the limit of detection. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

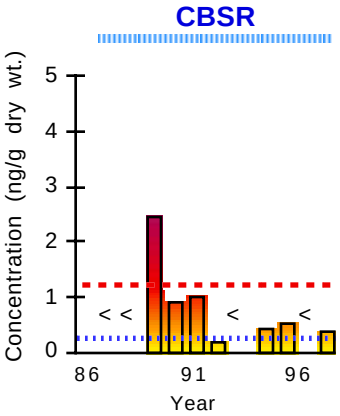
Mirex in oysters

Pensacola Bay



Choctawhatchee Bay





Mirex in oysters

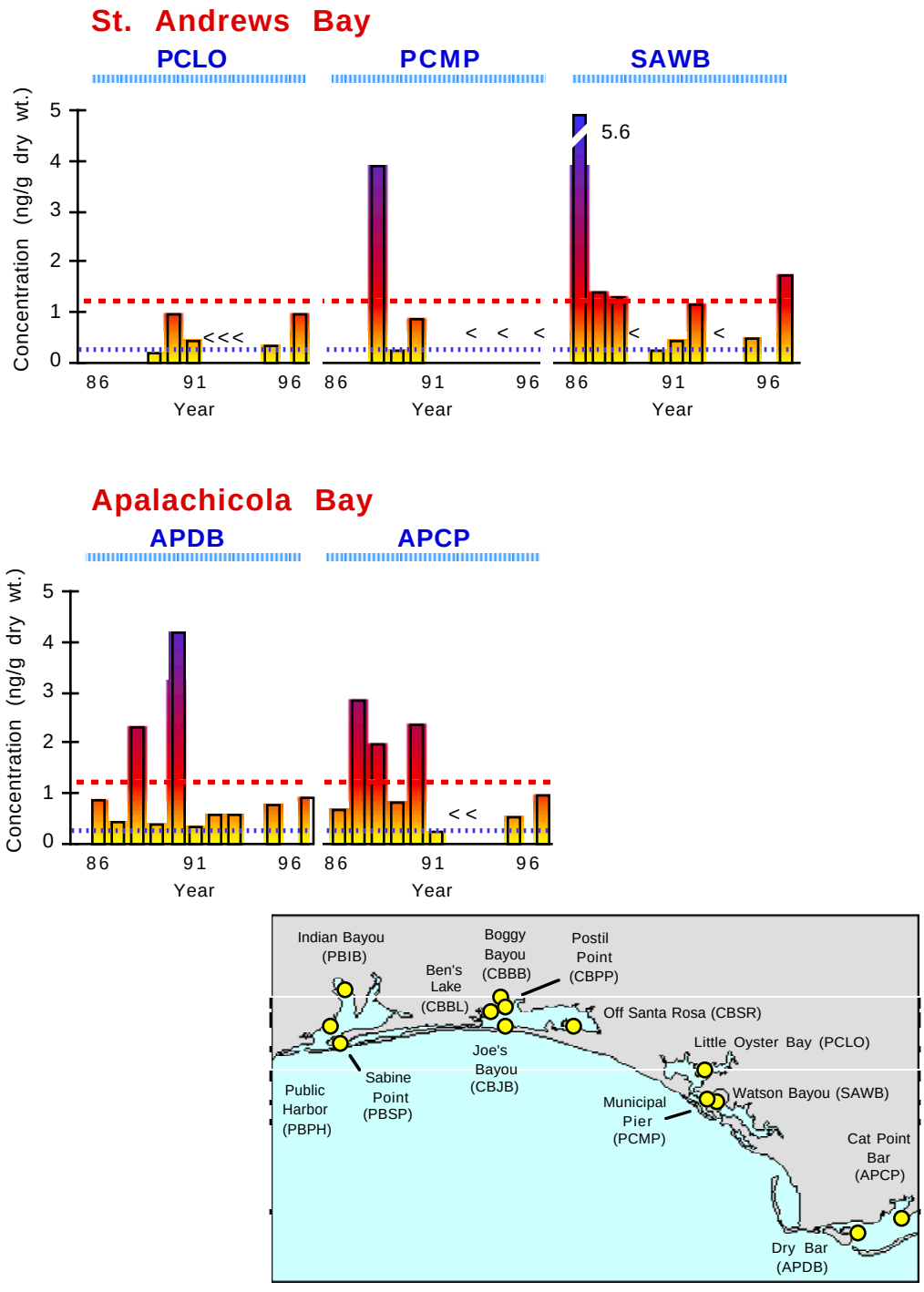
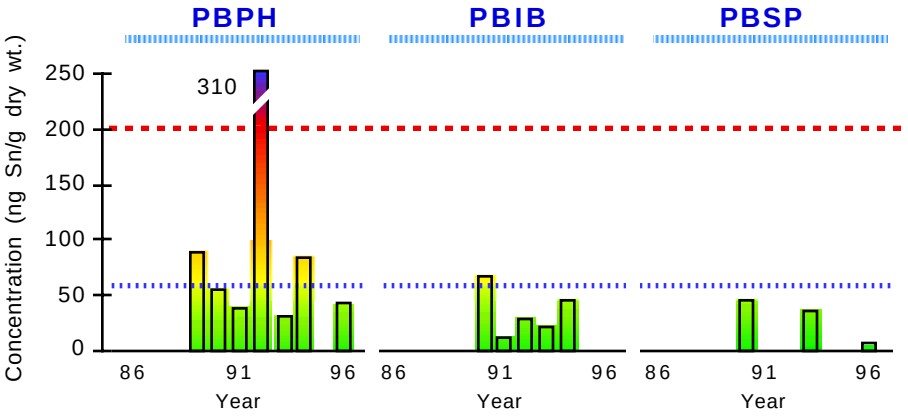


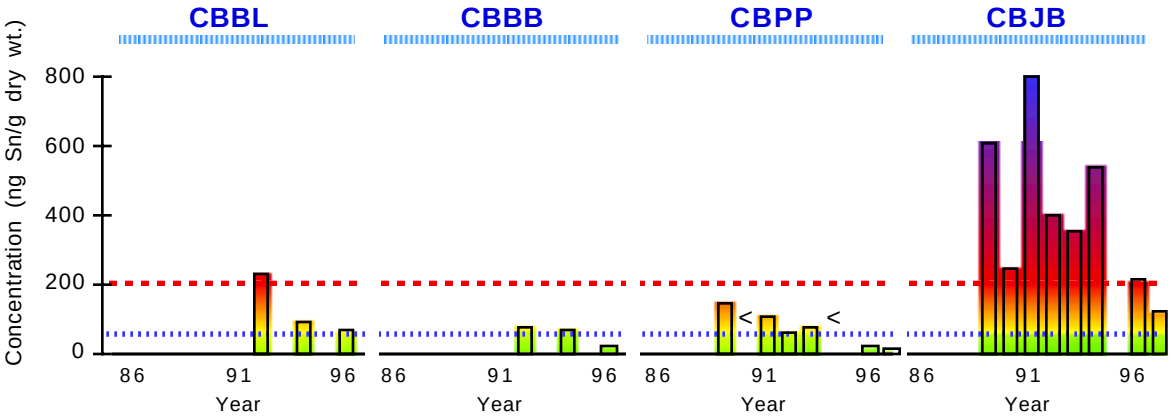
Figure II.17. Mirex trends in oysters. A "<" used to indicate values below the limit of detection. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

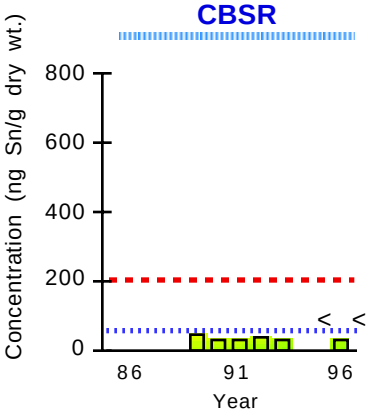
Total butyltins in oysters

Pensacola Bay



Choctawhatchee Bay





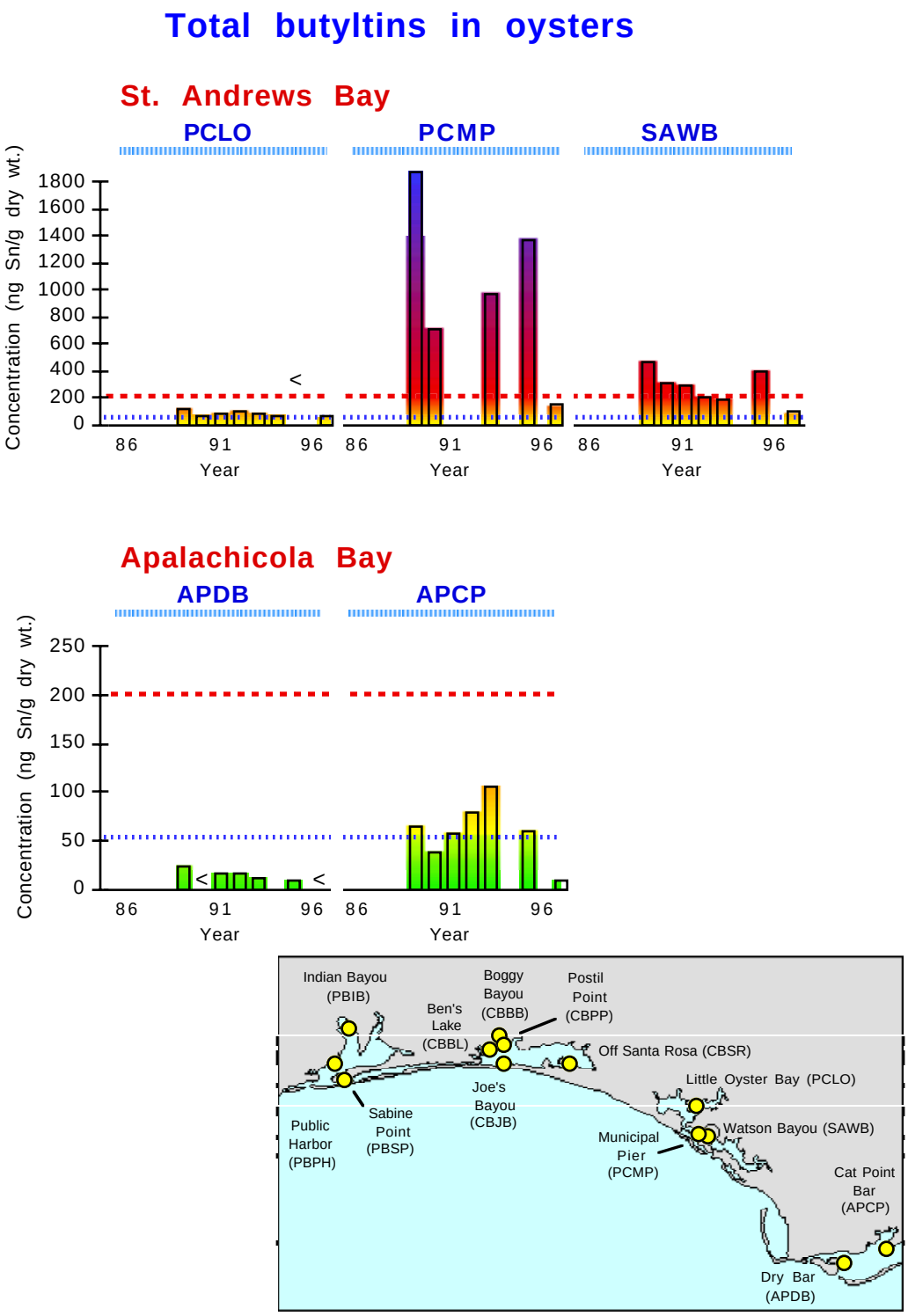


Figure II.18. Total tributyltins trends in oysters. A "<" used to indicate values below the limit of detection. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng Sn/g dry wt.).

U.S. Secretary of Commerce
Donald Evans

Acting Under Secretary of Commerce for Oceans and Atmosphere, and Administrator
National Oceanic and Atmospheric Administration
Scott B. Gudes

Senior Advisor to the Secretary of Commerce
John McCutcheon

Acting Assistant Administrator for Ocean Services and Coastal Zone Management
National Ocean Service
Margaret Davidson